









PTP 500 Series User Guide



MOTOROLA POINT-TO-POINT WIRELESS SOLUTIONS

MOTOROLA

MOTOROLA, Inc.

Point-to-Point Wireless Bridges – PTP 500 Series

Software Release PTP 500-03-xx

System User Guide

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1 About This User Guide

Congratulations on the purchase of the PTP 500 Series Bridge from Motorola. The PTP 500 Series Bridge is the latest innovation in high-speed wireless networking that lets you deploy wireless networks in areas previously unattainable.

This guide describes the installation, commissioning, operation and fault finding of the Motorola PTP 500 Series of Point-to-Point Wireless Ethernet Bridges. It contains the following main sections:

- 2 Product Description
- 3 Product Features
- 4 Planning Considerations
- 6 Installation
- 7 Web Page Reference
- 8 Recovery Mode
- 5 Lightning Protection
- 9 Troubleshooting (Fault Finding)
- 10 Connectorized PTP 500 Series Bridge
- 11 E1/T1 Installation Guide
- 12 Data Rate Calculations
- 13 AES Encryption
- 14 Remote Software Upgrade by TFTP
- 15 Legal Notices
- 16 PTP 500 Reference Information

1.1 Who Should Use This Guide

The guide is for use by the system installer and the end user IT professional. The system installer will require expertise in the following areas:

- Outdoor radio equipment installation
- Network configuration
- Use of web browser for system configuration, monitoring and fault finding

1.2 Contact Information

Table 1 - Contact Information

Postal Address:	Motorola, Inc. Unit A1, Linhay Business Park, Eastern Road, Ashburton, Devon. TQ13 7UP United Kingdom
Web Site:	http://www.motorola.com/ptp
Sales Enquiries:	sales.ptp@motorola.com
Web Support:	http://www.motorola.com/ptp/support
Email Support:	support.ptp@motorola.com
All Other Enquiries:	info.ptp@motorola.com
Telephone Enquiries and Global Support:	+1 (0) 877 515 0400 (Toll Free in the USA) and +44 (0) 808 234 4640 (Toll Free in the UK).

We welcome your feedback on the PTP 500 Series Bridge system documentation. This includes feedback on the structure, content, accuracy, or completeness of our documents, and any other comments you have. Send feedback to support.ptp@motorola.com.

1.3 Interpreting Typeface and Other Conventions

1.3.1 Fonts

Motorola PTP system documents employ distinctive fonts to indicate the type of information, as described in **Table 2**.

Table 2 - Font types

Font	Type of Information
variable width bold	Selectable option in a graphical user interface or settable parameter in a web-based interface.
`constant width regular`	Literal system response in a command-line interface.
`constant width italic`	Variable system response in a command-line interface.
`constant width bold`	Literal user input in a command-line interface.
`constant width bold italic`	Variable user input in a command-line interface.

1.3.2 Terminology

Motorola PTP system documents employ specific imperative terminology as follows:

- 'Type' means type the following characters.
- 'Enter' means type the following characters and then press **Enter**.
- 'Highlight' means click anywhere in a row of data to highlight the entire row.
- 'Select' means use the mouse to click on or branch to the menu item that follows.

1.3.3 Warnings, Cautions and Notes

The following describes how warnings, cautions and notes are used in Motorola PTP system documents.

1.3.3.1 Warnings

Warnings precede instructions that contain potentially hazardous situations. Warnings are used to alert the reader to possible hazards that could cause loss of life or physical injury. A warning has the following format:

⚠ WARNING

Warning text and consequence for not following the instructions in the warning.

1.3.3.2 Cautions

Cautions precede instructions and are used when there is a possibility of damage to systems, software, or individual items of equipment within a system. However, this damage presents no danger to personnel. A caution has the following format:

⚠ CAUTION

Caution text and consequence for not following the instructions in the caution.

1.3.3.3 Notes

A note means that there is a possibility of an undesirable situation or provides additional information to help the reader understand a topic or concept. A note has the following format:

NOTE

Note text.

1.4 Getting Additional Help

To get information or assistance as soon as possible for problems that you encounter, follow this procedure:

1. Search this document, the user manuals that support the modules, and the software release notes of supported releases:
    i. In the Table of Contents for the topic.
    ii. In the Adobe Reader® search capability for keywords that apply (Reader is a registered trademark of Adobe Systems, Incorporated).
2. Visit the Motorola website at www.motorola.com/ptp
3. Ask your Motorola products supplier to help.
4. Gather information from affected units such as:
    i. the IP addresses and MAC addresses
    ii. the software releases
    iii. the configuration of software features
    iv. any available diagnostic downloads
5. Escalate the problem to Motorola Technical Support as follows. You may either:
    i. Send e-mail to support.ptp@motorola.com
    ii. Call our 24x7 Technical Support Center on +1 (0) 877 515 0400 (Worldwide) or +44 (0) 808 234 4640 (UK Customers).

For warranty assistance, contact your reseller or distributor for the process.

1.5 Repair and Service

For unit repair or service, contact your service provider or an authorized Motorola Point-to-Point Distributor for Return Material Authorization (RMA) and shipping instructions. Alternatively, contact the PTP Global Technical Support Center to process an RMA.

1.6 Warranty

Motorola's standard hardware warranty is for one (1) year from date of shipment from Motorola or a Motorola Point-to-Point Distributor. Motorola warrants that hardware will conform to the current relevant published specifications and will be free from material defects in material and workmanship under normal use and service. Motorola shall within this time, at its own option, either repair or replace the defective product within thirty (30) days of receipt of the defective product. Repaired or replaced product will be subject to the original warranty period but not less than thirty (30) days.

Motorola warranty for software is described in details in 15.1 "Motorola Inc. End User License Agreement".

1.7 Electrical Safety

⚠ WARNING

To prevent loss of life or physical injury, observe the safety guidelines in this section.

Power lines: Use extreme care when installing antennas near power lines.

Working at heights: Use extreme care when working at heights.

Grounding: The Outdoor Unit (ODU) for the PTP 500 Series Bridge must be properly grounded to protect against lightning. In the USA and Canada it is the user's responsibility to install the equipment in accordance with Section 810 of the National Electric Code, ANSI/NFPA No.70-1984 or Section 54 of the Canadian Electrical Code. These codes describe correct installation procedures for grounding the outdoor unit, mast, lead-in wire and discharge unit, size of grounding conductors and connection requirements for grounding electrodes. Other regulations may apply in different countries and therefore it is recommended that installation of the outdoor unit be contracted to a professional installer.

Protective earth: The ODU for the PTP 500 Series Bridge must be grounded to a Protective Earth in accordance with the Local Electrical Regulations.

PIDU Plus: It is recommended that the supplied Power Indoor Plus (PIDU Plus PTP 300/500/600 Series) is used to power the PTP 500 Series Bridge ODU. The use of other power sources may invalidate safety approval and affect your warranty.

Cable measuring card: A cable measuring card must NEVER be used at the ODU end connected to power from the PIDU Plus. It must only be used at the bottom of the mast with a multimeter. This is because the PIDU Plus voltage exceeds the limit allowed in some countries for safe handling in wet conditions and therefore may create a safety hazard.

Alternative DC supplies: When using alternative DC supplies (via the PIDU Plus DC in terminals as described in Section 2.8 "Redundancy and Alternative Powering Configurations"), such as battery-backed DC power source, the supply MUST comply with the following requirements:

- The voltage and polarity is correct and is applied to the correct terminals in the PIDU Plus
- The power source is rated as SELV
- The power source is rated to supply at least 1A continuously
- The power source cannot provide more than the Energy Hazard Limit as defined by IEC/EN/UL6090, Clause 2.5, Limited Power (The Energy Hazard Limit is 240VA)

Primary disconnect device: The main power supply is the primary disconnect device.

External cables: Safety will be compromised if external quality cables are not used for connections that will be exposed to the weather.

Non-Motorola power supply: Safety will be compromised if a different power supply is used than the one supplied by Motorola as part of the system.

1.8 RF Safety

⚠ WARNING

To protect from overexposure to RF energy, observe the safety guidelines in this section.

1.8.1 RF Exposure Near the Antenna

Minimum separation distance: Install the radios for the PTP 500 family of PTP wireless solutions so as to provide and maintain the minimum separation distances from all persons. The minimum separation distances for each frequency variant are specified in Section 1.8.4 “Calculated Distances and Power Compliance Margins”.

Avoid standing in front of the antenna: When the system is operational, avoid standing directly in front of the antenna. Strong RF fields are present when the transmitter is on. The Outdoor Unit (ODU) must not be deployed in a location where it is possible for people to stand or walk inadvertently in front of the antenna.

1.8.2 Limits and Guidelines for RF Exposure

Limits and guidelines for RF exposure come from:

- US FCC limits for the general population. See the FCC web site at http://www.fcc.gov, and the policies, guidelines, and requirements in Part 1 of Title 47 of the Code of Federal Regulations, as well as the guidelines and suggestions for evaluating compliance in FCC OET Bulletin 65.
- Health Canada limits for the general population. See the Health Canada web site at http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/limits-limites_e.html and Safety Code 6.
- EN 50383:2002 Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz - 40 GHz).
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines for the general public. See the ICNIRP web site at http://www.icnirp.de/ and Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields.

1.8.3 Power Density Exposure Limit

The applicable power density exposure limit from the documents referenced above is:

- 10 W/m^2 for RF energy in the 2.4-, 5.2-, 5.4-, 5.8- and 5.9 GHz frequency bands.

Peak power density in the far field of a radio frequency point source is calculated as follows:

Equation 1 - Peak power density in the far field

$$S = \frac{P.G}{4\pi d^2}$$ Where

S	power density in W/m^2
P=	Maximum Average transmit power capability of the radio, in
G=	total Tx gain as a factor, converted from dB
d	distance from point source, in m

Rearranging terms to solve for distance yields:

$$d = \sqrt{\frac{P.G}{4\pi.S}}$$

1.8.4 Calculated Distances and Power Compliance Margins

Table 3 shows calculated minimum separation distances d, recommended distances and resulting power compliance margins for each frequency band and antenna combination.

These are conservative distances that include compliance margins. At these and greater separation distances, the power density from the RF field is below generally accepted limits for the general population.

Table 3 - Power Compliance Margins

Band	Antenna	Max Average Transmit Power in Burst (Watt)	Variable			d (m)	Recommended Distance (m)	Power Compliance Margin
			P (Watt)	G	S (W/m^2)			
5.4 GHz	Integrated	0.005 (7 dBm)	0.00250	200 (23 dBi)	10	0.06	1	15.9
	External 4ft Dish	0.00035 (-4.6 dBm)	0.00017	2884 (34.6 dBi)	10	0.06		
EU 5.8 GHz	Integrated	0.020 (13 dBm)	0.01	200 (23 dBi)	10	0.13	1	7.6
	External 4ft Dish	0.0014 (-1.4 dBm)	0.0007	2884 (34.6 dBi)	10	0.13	1	7.6
FCC 5.8 GHz	Integrated	0.32 (25 dBm)	0.16	200 (23 dBi)	10	0.5	2	4.0
	External 2ft Flat Plate	0.32 (25 dBm)	0.16	631 (28 dBi)	10	0.9	4	4.5
	External 6ft Dish	0.32 (25 dBm)	0.16	6310 (38 dBi)	10	2.83	10	3.5

NOTE

The regulations require that the power used for the calculations is the maximum power in the transmit burst subject to allowance for source-based time-averaging.

At 5.4 GHz and EU 5.8 GHz, the products are generally limited to a fixed EIRP which can be achieved with the Integrated Antenna. The calculations above assume that the maximum EIRP allowed by the regulations is being transmitted.

If there are no EIRP limits in the country of deployment, use the distance calculations for FCC 5.8 GHz for all frequency bands.

At FCC 5.8 GHz, for antennas between 0.6m (2ft) and 1.8m (6ft), alter the distance proportionally to the antenna gain.

1.9 Compliance with Regulations

1.9.1 General

Changes or modifications not expressly approved by Motorola could void the user's authority to operate the system.

This system has achieved Type Approval in various countries around the world. This means that the system has been tested against various local technical regulations and found to comply. The frequency bands in which the system operates may be 'unlicensed' and, in these bands, the system can be used provided it does not cause interference. Further, it is not guaranteed protection against interference from other products and installations.

⚠ CAUTION

When planning a link that will use Connectorized PTP 500 Series bridges (with external antennas), ensure that regulatory requirements are met for the installation, as described in Section 10.5 "Regulatory Issues with Connectorized Units".

1.9.2 FCC and ETSI Compliance Testing

The system has been tested for compliance to both US (FCC) and European (ETSI) specifications. It has been shown to comply with the limits for emitted spurious radiation for a Class B digital device, pursuant to Part 15 of the FCC Rules in the USA and appropriate European ENs. These limits have been designed to provide reasonable protection against harmful interference. However the equipment can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other radio communications. There is no guarantee that interference will not occur in a particular installation.

NOTE

A Class B Digital Device is a device that is marketed for use in a residential environment, notwithstanding use in commercial, business and industrial environments.

1.9.3 Radio and Television Interference

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the Outdoor Unit (ODU).
- Increase the separation between the affected equipment and ODU.
- Connect the ODU and PIDU Plus into a power outlet on a circuit different from that to which the receiver is connected.
- Consult your installer or supplier for help.

1.9.4 Deployment and Operation

The Radio Regulations of various countries' limits constrain the operation of radio products generally. In particular the local regulator may limit the amount of conducted or radiated transmitter power and may require registration of the radio link.

The power transmitted by the PTP 500 Series Bridge is controlled by the use of Region-specific License Keys. Contact your supplier/installer to ensure that your product is set for the correct License Key for your Country/Region and to ensure that you have fulfilled all the local regulatory requirements, especially if you are intending to use a link with external antennas.

1.9.5 Examples of Regulatory Limits

For examples of how the regulatory limits apply to each frequency variant in specific countries, refer to:

- Section 16.2.1 PTP 54500 Examples of Regulatory Limits
- Section 16.3.1 PTP 58500 Examples of Regulatory Limits

1.9.6 Registration of Links

UK Registration of Links – OfCom, The application form may be found at:

http://www.ofcom.org.uk/radiocomms/isu

Eire Registration of Links – Commission for Communication Regulation, The application form may be found at:

http://www.comreg.ie/licensing_and_services

2 Product Description

This section provides a high level description of the PTP 500 product. It describes in general terms the function of the product, the main product variants and typical deployment. It also describes the main hardware components.

The following topics are described in this section:

- 2.1 Product Function
- 2.2 Typical Deployment
- 2.3 Frequency Variants
- 2.4 Other Product Variants
- 2.5 Network Connection
- 2.6 Outdoor Unit (ODU)
- 2.7 PIDU Plus PTP 300/500/600 Series
- 2.8 Redundancy and Alternative Powering Configurations
- 2.9 Remote LEDs and Recovery Switch
- 2.10 Cables and Connectors
- 2.11 PTP and Lightning Protection
- 2.12 Mounting Brackets

2.1 Product Function

The PTP 500 Series Bridge has been developed to provide Point-to-Point data connectivity via a wireless Ethernet bridge operating at broadband data rates.

The PTP 500 Series Bridge offers true Non Line Of Sight (NLOS) operation by using a combination of Orthogonal Frequency Division Multiplexing (OFDM) modulation and Multiple-Input Multiple-Output (MIMO) techniques. These technologies enable the PTP 500 Series Bridge to drive through foliage and around buildings to such an extent that almost universal coverage can be expected at short range.

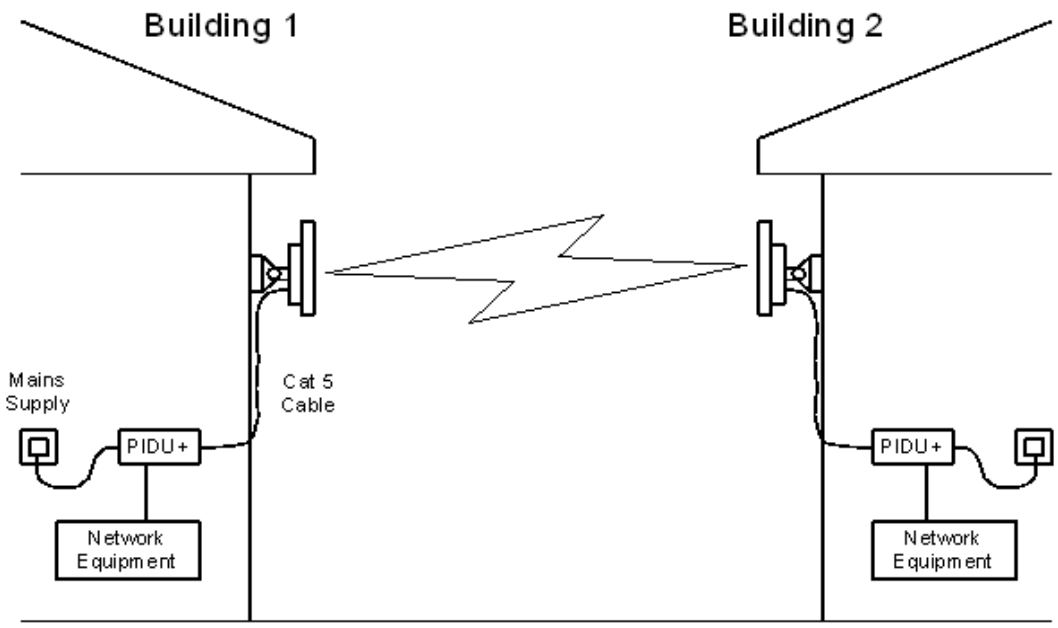
The PTP 500 Series Bridge has been designed to coexist with other users of the band in an optimal fashion using a combination of Transmit Power Control (TPC), Spectrum Management functionality and Antenna beam shape. In order to maintain link availability, the product employs adaptive modulation techniques that dynamically reduce the data rate in severe or adverse conditions.

2.2 Typical Deployment

The PTP 500 Series Bridge consists of an identical pair of units deployed one at each end of the link. The radio link operates on a single frequency channel in each direction using Time Division Duplex (TDD). One unit is deployed as a master and the other as a slave. The master unit takes responsibility for controlling the link in both directions.

The PTP 500 Series Bridge is aimed at a wide range of applications. An example application is an enterprise that has a requirement to connect together the Local Area Network (LAN) of two or more buildings as shown in Figure 1.

Figure 1 - Typical PTP 500 Series Bridge Deployment



Each end of the link consists of:

- **Outdoor Unit (ODU):** An integrated (or connectorized -see section 10 “Connectorized PTP 500 Series Bridge”) outdoor transceiver unit containing all the radio and networking electronics.
- **PIDU Plus:** An indoor connection box containing a mains power supply, status indicators and network connection port.

A pair of units is normally supplied pre-configured as a link.

2.3 Frequency Variants

The PTP 500 Series Bridge has been developed to operate within license exempt frequency bands. The frequency variants are listed in Table 4.

Table 4 - PTP 500 Series Bridge Frequency Variants

Variant	Definition	Frequency Coverage	Variable Channel Width	Channel Raster
PTP 54500	ETSI 5 GHz Band B FCC UNII Band	5470-5725 MHz	5, 10, 15 MHz	5 MHz
PTP 58500	ETSI Band, FCC ISM Band	5725-5875 MHz (ETSI) and 5725-5850 MHz (FCC)	5, 10, 15 MHz	5 MHz

NOTE

The user must check that local regulations allow the use of these frequency variants.

2.4 Other Product Variants

The PTP 500 Lite version has lower data throughput rates then the Full version.

The PTP 500 outdoor unit (ODU) may be integrated (with its own antenna) or connectorized (with a separate antenna).

2.5 Network Connection

The network connection to a PTP 500 Series Bridge is made via a 100BaseT Ethernet connection. Power is provided to the ODU over the 100BaseT Ethernet connection using a patented non-standard powering technique.

Power is fed into the PIDU Plus from the mains via a standard “figure of eight” mains plug. Connection between the ODU and PIDU Plus is made using standard CAT5e outdoor UV resistant cable. Connection between the PIDU Plus and the Network Equipment is made using standard CAT5e cable.

2.6 Outdoor Unit (ODU)

The ODU is a self-contained unit. It houses both radio and networking electronics. The ODU for the PTP 500 Series Bridge should only be deployed using the supplied PIDU Plus PTP 300/500/600 Series. Figure 2 shows an installation example of a PTP 500 Series ODU.

Figure 2 – PTP 500 Series Bridge Outdoor Unit (ODU)



2.7 PIDU Plus PTP 300/500/600 Series

The PIDU Plus PTP 300/500/600 Series (Figure 3) is used to generate the ODU supply voltage from the mains supply (or from an external DC source) and inject this supply voltage into the 100BaseT Ethernet connection to the ODU. Connection uses a CAT5e cable using standard RJ45 wiring.

⚠ CAUTION

Care should be taken not to connect equipment other than an ODU or LPU for the PTP 500 Series Bridge to a PIDU Plus ODU port, as equipment damage may occur. The PIDU Plus PTP 300/500/600 Series is not interchangeable with the PIDU Plus PTP 400 Series.

Figure 3 - Power Indoor Unit (PIDU Plus PTP 300/500/600 Series)



2.7.1 Power and Ethernet LEDs

The front panel contains indicators showing the status of the power and Ethernet connections:

- The Power indicator is illuminated when the PIDU Plus is receiving mains power.
- The Ethernet indicator normally illuminates when the Ethernet link is working, flashing when there is Ethernet activity. The fact that it lights also indicates that the ODU is powered. At power up the LED will flash 10 times to indicate that a correct start up sequence has occurred. See Section 9 “Fault Finding” for further fault finding information.

2.7.2 ODU, LAN and Recovery

At the bottom of the PIDU Plus is an entry point for the PIDU Plus to ODU cable, the 100BaseT Ethernet network port and the Recovery switch.

Figure 4 – PIDU Plus Recovery Switch Location



The Recovery switch is used to recover the unit from configuration errors or software image corruption. To put an ODU into recovery mode, the Recovery switch should be pressed, then the power applied. The Recovery switch should be kept pressed for at least 30 seconds after the power has been applied. Full instruction on the recovery mode can be found in Section 8 “Recovery Mode”.

A simple reboot can be performed by removing and re-applying the mains power to the PIDU Plus.

2.7.3 DC In and Out

On the left hand side of the PIDU Plus, 48V DC input and output connections can be found. These are used to power the PTP 500 Series Bridge from an external DC source or to provide a level of power supply redundancy, as shown in Section 2.8 “Redundancy and Alternative Powering Configurations”.

2.7.4 Remote Connectors and Jumpers

Also on the left hand side of the PIDU Plus, connectors and jumpers can be found that allow the remote connection of power LED, Ethernet LED and Recovery switch. The connection instructions can be found in Section 2.9 “Remote LEDs and Recovery Switch”.

2.7.5 Mains Connection

The input supply range for the PIDU Plus is 90V-264V AC, 47-63Hz. Mains connection to the PIDU Plus is made using a standard “figure of eight” mains lead as shown in Figure 6.

Figure 5 – PIDU Plus Power Input



2.8 Redundancy and Alternative Powering Configurations

The PTP 500 Series Bridge can be powered from an external DC source and can be provided with power supply redundancy as follows:

- External DC supply only (Figure 6): This configuration is for use where there is no mains supply.
- External DC supply and AC supply (Figure 7): This configuration provides redundancy through the use of mains and DC supply.
- External DC supply and redundant AC Supply (Figure 8): This configuration guards against mains failure and failure of the DC output of single PIDU Plus.

NOTE

The use of DC supplies of less than 55v will reduce the usable distance between the PIDU Plus and ODU.

CAUTION

The maximum distance from the ODU to the connected network equipment is 100 m (330 ft) when using 100BaseT.

Figure 6 - External DC Supply Only

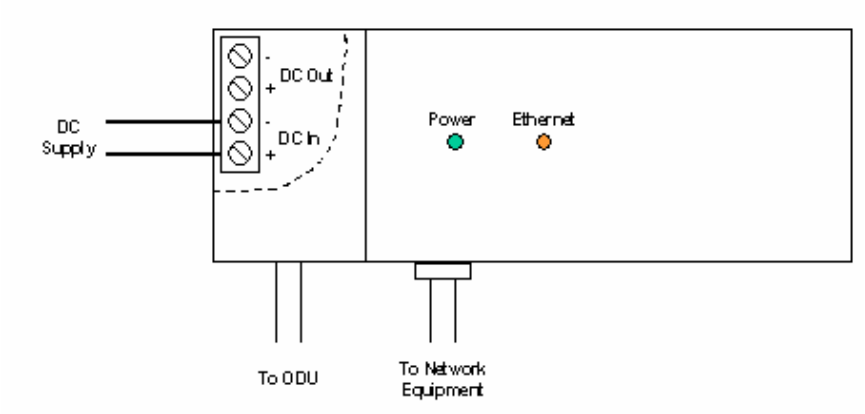


Figure 7 - External DC Supply and AC Supply

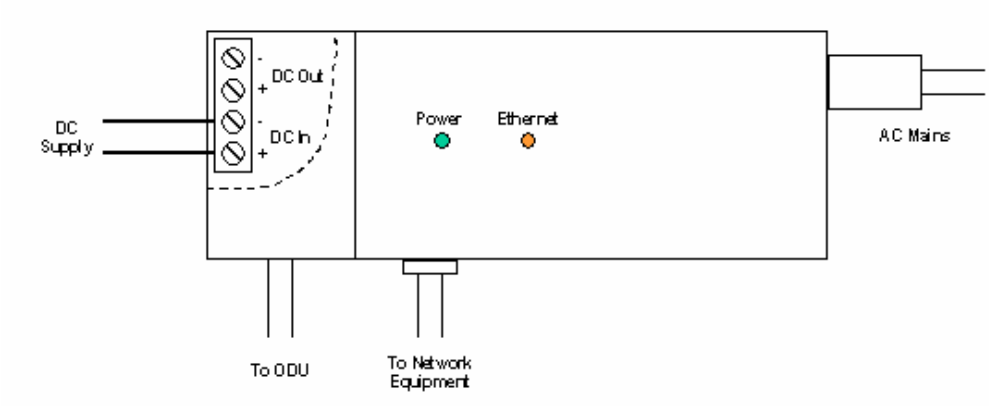
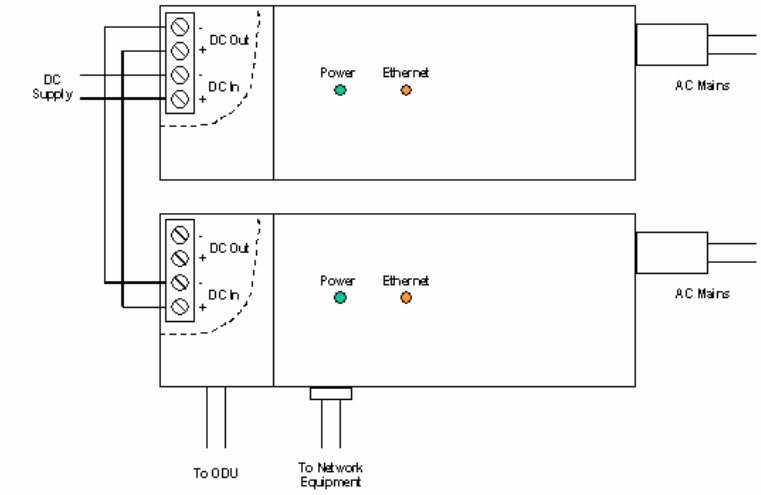


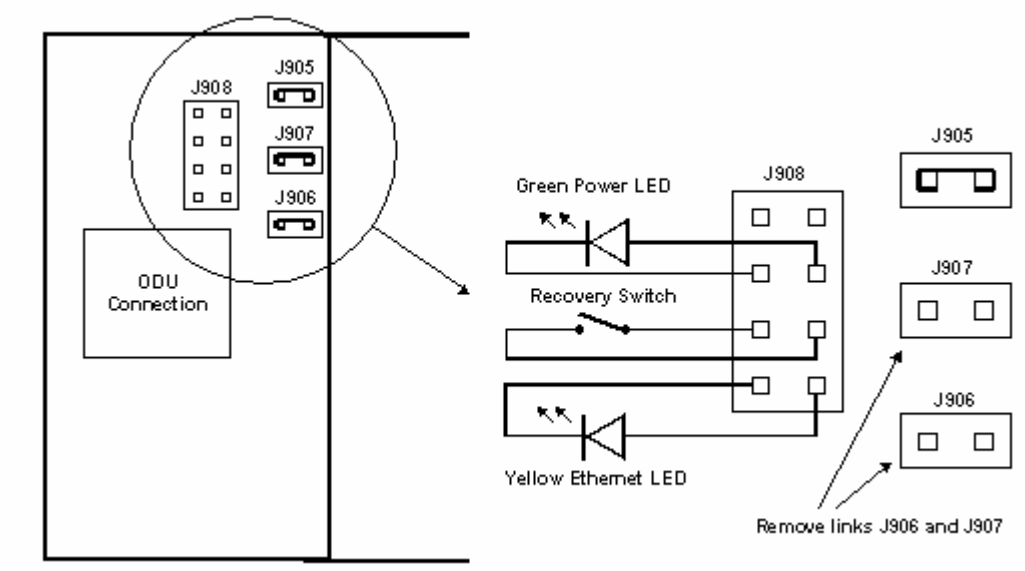
Figure 8 - External DC Supply and Redundant AC Supply



2.9 Remote LEDs and Recovery Switch

The PIDU Plus provides a facility to connect remote LEDs and Recovery switch allowing the PIDU Plus to be mounted inside an enclosure. At the left hand end of the PIDU Plus under the ODU connection cover can be found a PCB header and three jumpers. Jumpers J906 and J907 should be removed and connection to the remote LEDs and Recovery switch made to J908 as shown in Figure 9.

Figure 9 - Remote LED and Recovery Switch Wiring



2.10 Cables and Connectors

The cable used to connect the PIDU Plus to the ODU can be any standard CAT5e type provided that it is UV resistant and suitable for outdoor deployment. Motorola recommends that cables to the specification below be used:

Cable: **Superior Essex BBDGE CAT 5e**

Connector Type: **Tyco, 5-569278**

Gland: **Motorola WB1811**

⚠ CAUTION

Failure to use the recommended (or equivalent) standard of cable may invalidate the system's safety certification.

The cable used to connect the PIDU Plus to the users Network Equipment can be any standard CAT5e Cable.

The PIDU Plus to ODU and the PIDU Plus to Network Equipment cables may be unscreened (UTP) or screened (STP). However, unscreened cables reduce the system's ability to cope with nearby lightning strikes. If lightning activity is common in the area of deployment, the use of screened cable is highly recommended. See Section 5 "Lightning Protection".

The PIDU Plus provides screen continuity between the ODU and Network Equipment connections.

NOTE

The ODU network connection implements automatic MDI/MDI-X sensing and pair swapping allowing connection to networking equipment that require cross-over cables (MDI-X networks) or straight-through cables (MDI Networks).

2.11 PTP and Lightning Protection

The PIDU Plus meets the low level static discharge specifications identified in Section 16 "PTP 500 Reference Information", but does not provide lightning or surge suppression.

The amount of lightning protection is dependent on regulatory requirements and the end user requirements. The standard ODU for the PTP 500 Series Bridge is fitted with surge limiting circuits and other features to minimize the risk of damage due to nearby lightning strikes. These standard features may require some additional equipment to be configured as part of the system installation to be fully effective.

A separate Ethernet surge suppressor must be used and appropriately earthed. Suitable surge suppressors can be sourced from your Motorola Point-to-Point Distributor or Solutions Provider. See Section 5 "Lightning Protection"

CAUTION

Motorola recommends the use of screened cable and Lightning Protection units to protect connected equipment from nearby strikes.

The PTP 500 Series Bridge is not designed to survive direct lightning strikes. For this reason the unit should not be installed as the highest point in a localized area, unless specific precautions are taken. See Section 5 "Lightning Protection".

2.12 Mounting Brackets

The ODU is supplied with a bracket for mounting it to a pole of 50mm (2”) to 75mm (3”) in diameter. For more details on mounting, see Section 6 “Installation”.

The bracket allows for adjustment in both azimuth and elevation. The bracket may be split to allow the pole mount section of the bracket to be mounted to the pole first. This allows the installer to take the weight of the unit and secure it, one handed, with a single mounting bolt.

The PIDU Plus can either be desk or wall mounted. The preference is wall mounted, with the cables dressed to a cable channel. Wall mounting is achieved by screwing through the mounting lugs on either side of the unit. Remember to leave space for access to the Recovery button. See Section 2.7 “PIDU Plus PTP 300/500/600 Series”.

3 Product Features

This section provides descriptions of the main features of PTP 500 product architecture.

The following topics are described in this section:

- 3.1 Ethernet Frames
- 3.2 Management Function
- 3.3 Configuration and Management
- 3.4 Channel Bandwidth and Link Symmetry Control
- 3.5 Non Line Of Sight (NLOS) and Line Of Sight (LOS)
- 3.6 Upgradeable Software
- 3.7 Networking Information
- 3.8 Link Mode Optimization
- 3.9 Telecoms Circuits
- 3.10 Radar Avoidance

3.1 Ethernet Frames

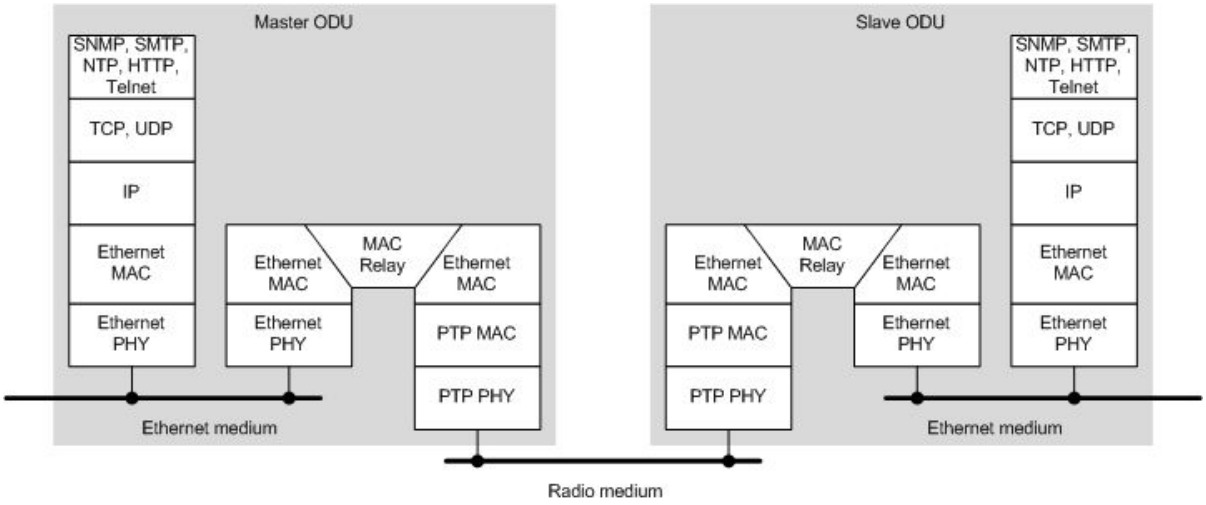
The PTP 500 series provides wireless Ethernet bridging between two fixed locations. To be more precise, it forwards Ethernet frames as a two-port transparent heterogeneous encapsulation bridge, meaning that each bridge forwards frames between two dissimilar interfaces (Ethernet and wireless), encapsulating Ethernet MAC frames within a PTP MAC frames for transmission at the wireless interface. A link consisting of a pair of back to back bridges appears to the data network to be very similar to a standard two-port Ethernet bridge.

The PTP 500 series provides eight traffic classes, classifying Ethernet frames into one of eight prioritized queues based on inspection of the user priority field (802.1p) in a customer (IEEE802.1Q) VLAN tag or provider (IEEE802.1ad) VLAN tag. Untagged frames receive a default priority. The scheduling method is strict priority. The bridge does not implement any VLAN functions for bridged frames apart from inspection of the priority field, and consequently the bridge forwards tagged and untagged Ethernet frames regardless of VLAN ID and without modification of any protocol header field.

3.2 Management Function

The management function of the PTP 500 Series Bridge is logically equivalent to a separate protocol stack with virtual point of attachment at the Ethernet interface. This is illustrated in Figure 10.

Figure 10 – PTP 500 Series Bridge Layer Diagram



Each unit in the link is manageable through an IP connection. Standard IP protocols are utilized for all management functions, for example, HP, SNMP, etc. The unit can be configured to use a VLAN with a single C-tag or S-tag on the management interfaces.

3.3 Configuration and Management

Configuration and Management of the PTP 500 Series Bridge is implemented using an inbuilt web server hosting a number of Configuration and Management web pages. This approach allows Configuration and Management to be carried out on any standard web browsing technology. The PTP 500 Series Bridge can also be managed remotely using the SNMP management protocol. Connection to the bridge is via the Ethernet connection carrying the bridge network traffic. Connection to the unit is via a preset IP address. This address can be changed via the Network Interface Configuration web page. A full explanation of the available web pages and their use can be found in Section 7 “Web Page Reference”.

3.4 Channel Bandwidth and Link Symmetry Control

The PTP 500 series provides configurable channel bandwidth in the radio link (5 MHz, 10 MHz and 15 MHz depending on the frequency band for the bandwidth choice), and configurable fixed and adaptive link symmetry. Fixed link symmetry supports:

- 3:1
- 1:1
- 1:3

Channel bandwidth 5 MHz supports link symmetry 1:1 only.

3.5 Non Line Of Sight (NLOS) and Line Of Sight (LOS)

The PTP 500 Series Bridge is designed to operate in both Non Line Of Sight (NLOS) and Line Of Sight (LOS) environments.

3.6 Upgradeable Software

The PTP 500 Series Bridge is fully software upgradeable. New software images are first downloaded from the Motorola website http://www.motorola.com/ptp to a convenient computer. The image is then uploaded to the ODU via the web management page described in Section 7.8 “Software Upgrade”. The compressed image is first loaded into RAM and check-summed. If the compressed image transfer has completed successfully the image is decompressed and written to flash memory. On completion of this process the unit can be rebooted to use the newly uploaded image. Should this process fail, the unit will revert to a protected compressed image installed during manufacturing to allow the unit to be recovered.

3.7 Networking Information

The PTP 500 Series Bridge operates as a transparent Ethernet bridge. Although each unit requires an IP address, this IP address is for management purposes only, and it plays no part in the forwarding of bridged Ethernet frames. IP addresses are assigned during initial configuration as described in Section 6 “Installation”.

3.8 Link Mode Optimization

Link Mode Optimization allows the PTP 500 link to be optimized according to the type of traffic that will be bridged. The link supports two modes: IP mode and TDM mode.

3.8.1 IP Link Mode Optimization

IP mode is optimized to provide the maximum possible link capacity. IP mode is an appropriate choice where applications in the bridged networks provide some measure of reliable transmission, and where very low latency is not critical.

IP mode supports both fixed and adaptive link symmetry (see Section 3.4 “Channel Bandwidth and Link Symmetry Control”).

3.8.2 TDM Link Mode Optimization

TDM mode is optimized to provide the lowest possible latency. TDM mode additionally implements a more conservative approach to adaptive modulation, leading to lower error rates in fading channels at the expense of slightly lower link capacity. TDM mode is an appropriate choice for delay intolerant data without reliable transmission (for example voice over IP data).

TDM mode supports fixed link symmetry only (see Section 3.4 “Channel Bandwidth and Link Symmetry Control”).

TDM mode is selected automatically when Telecom interfaces are enabled.

3.9 Telecoms Circuits

The PTP 500 link provides native support for one E1 link, or one T1 link. The link relays unstructured E1 or T1 data and provides accurate timing transfer.

3.9.1 Lowest Telecoms Modulation Mode

In narrow channel bandwidth and lower modulation modes, the link may have insufficient capacity to relay the E1/T1 payload; in this case, the wireless link continues to carries timing information in order to maintain accurate clock synchronization. The relay of telecoms data resumes automatically when the link reaches a suitable modulation mode.

Links that are able to operate consistently in a high modulation mode can take advantage of lower link latency. This option is configured by setting the "Lowest Telecoms Modulation Mode" during installation. Appropriate settings for this control may be determined by using the LINKPlanner tool. The reduction in latency is achieved by disabling the relay of telecoms data in lower modulation modes, and this necessarily results in somewhat lower availability for the telecoms circuit. The loss of availability can be estimated using the LINKPlanner.

The unit will override the user setting of Lowest Telecoms Modulation Mode if the selected mode has insufficient capacity to carry the telecoms data, or if the mode demands very high latency and requires more buffering than the link can provide. When the effective mode differs for Single and Dual Payload operation two modes will be displayed: "Lowest Dual Payload Modulation Mode" and "Lowest Single Payload Modulation Mode".

3.9.2 Fixed Frequency Operation

In the PTP 500 link, data errors may occur during channel changes on an operational link. It may be appropriate to minimize channel-change-related errors in a link carrying Telecoms traffic by preventing channel changes initiated by i-DFS. This can be achieved by barring all channels except one in the Spectrum Management page, or alternately by selecting Fixed Frequency mode. These steps disable interference avoidance mechanisms, and should not be taken if the risk of errors due to interference is more severe than the risk due to channel changes.

3.9.3 Further Reading

Installation details are provided in Section 11 “E1/T1 Installation Guide”.

The E1 or T1 circuit is configured using the web pages described in Section 7.5.5 “Telecoms Configuration” and 7.7.3.1 “Telecoms Interface”.

3.10 Radar Avoidance

Radar Avoidance requires that equipment used in the region:

- Detects interference from other systems and avoids co-channel operation with these systems, notably radar systems.
- Provide on aggregate a uniform loading of the spectrum across all devices, that is, Fixed Frequency operation is not allowed.

To address the primary aims, the Spectrum Management algorithm implements a radar detection function which looks for impulsive interference on the operating channel only. If impulsive interference is detected, Spectrum Management will mark the current operating channel as having detected radar (unavailable channel) and initiate a channel hop to an available channel. The previous operating channel will remain in the unavailable state for thirty minutes after the last impulsive interference pulse was detected. After the thirty minutes have expired the channel will be returned to the usable channel pool.

The equipment can only transmit on available channels, of which there are none at initial power up. The radar detection algorithm will always scan a usable channel for 60 seconds for radar interference before making the channel an available channel. This compulsory channel scan will mean that there is a 60 seconds service outage every time radar is detected and that the installation time is extended by 60 seconds even if there is found to be no radar on the channel.

NOTE

On system installation or start-up this extends the initial scan time of the Master unit by 60 seconds. To address the requirement to provide aggregate uniform loading of the spectrum across all devices, the channel selection algorithm will choose a channel at random from a list of useable channels. The channel selection algorithm is initiated at link initialization and when radar interference is detected.

4 Planning Considerations

This section provides information to help the user to plan a PTP 500 link.

Each frequency variant has specific licensing restrictions that affect frequency range, channel bandwidth, maximum power and radar avoidance. Link planning must take account of obstructions, site selection, path loss and wind loading.

The following topics are described in this section:

- 4.1 Spectrum Planning
- 4.2 Licenses and Region Codes
- 4.3 Radar Avoidance and Bandwidth Operation
- 4.4 Variable Channel Bandwidth Operation
- 4.5 Link Planning
- 4.6 Site Selection Criteria
- 4.7 Wind Loading
- 4.8 Path Loss Considerations
- 4.9 System Threshold, Output Power and Link Loss

To calculate the data throughput capacity of a planned PTP 500 link, see Section 12 “Data Rate Calculations”.

4.1 Spectrum Planning

The PTP 500 may use one of four alternative methods of spectrum planning. The choice of methods depends upon whether or not the region mandates radar detection.

4.1.1 Regions Without Mandatory Radar Detection

In regions that do not mandate DFS (Radar Detection), the frequencies may be configured symmetrically or asymmetrically (different transmit and receive frequencies). The Spectrum Management Control options are:

- **Intelligent Dynamic Frequency Selection (i-DFS)**: This method continually monitors the spectrum looking for the channel with the lowest level of on channel and co-channel interference. Statistical techniques are used to select the most appropriate transmit and receive channels. The i-DFS mode can be influenced in its channel decision process by selectively barring channels from use.

- **Fixed Frequency**: This method allows the installer to allocate fixed transmit and receive frequencies on the units.

4.1.2 Regions With Mandatory Radar Detection

In regions that mandate DFS (Radar Detection), the frequency must always be symmetrical (transmit and receive on the same frequency). The Spectrum Management Control options are:

- **Dynamic Frequency Selection (DFS)**: This method detects interference from other systems and avoids co-channel operation with these systems, notably radar systems.
- **DFS with i-DFS**: This method is similar to i-DFS. It differs in the event that several alternative channels are equally the best within the 1 dB measurement resolution. In **i-DFS**, the ODU selects the lowest channel number out of the set of best channels. In **DFS with i-DFS,** the ODU makes a random selection from the equal best channels.

4.2 Licenses and Region Codes

The PTP 500 Series Bridge uses a system of Region Codes to control the operation of the radio link. The user must ensure the product is configured to conform to local regulatory requirements by installing a License Key for the correct Region Code.

⚠ CAUTION

For the connectorized model, when using external antennas of higher gain than the appropriate integrated antenna, the regulations may require the maximum Tx power to be reduced. To ensure that regulatory requirements are met for connectorized installations, refer to Section 10.5 “Regulatory Issues with Connectorized Units”.

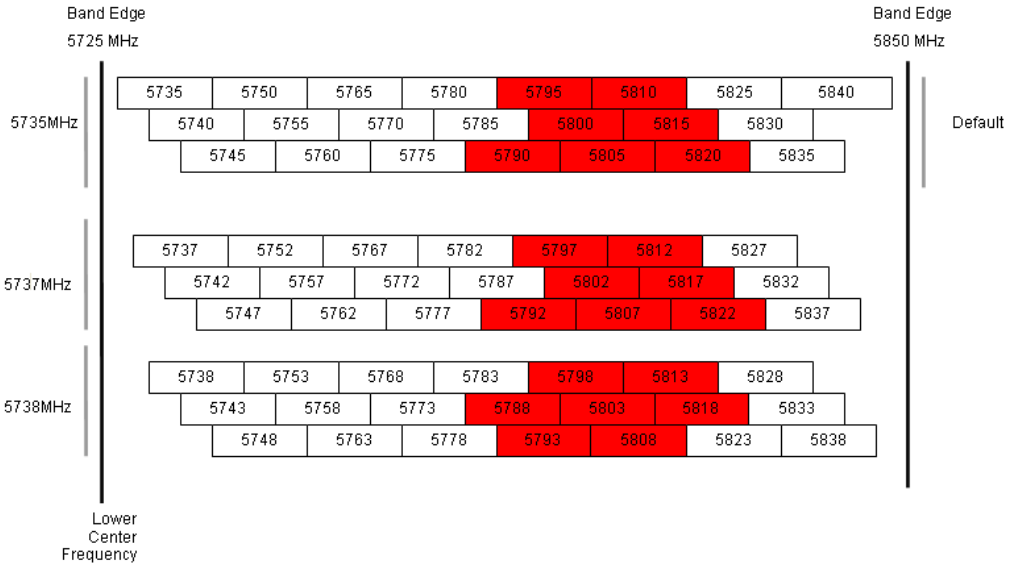
The license and region codes for each frequency variant are listed in:

- Section 16.2.2 PTP 54500 Licenses and Region Codes
- Section 16.3.2 PTP 58500 Licenses and Region Codes

4.3 Radar Avoidance and Bandwidth Operation

Where regulatory restrictions apply to certain channels these channels are barred. RTTT avoidance may be necessary in all channel bandwidths. The number of channels barred is dependant on the channel raster selected. For example see the effect of the UK RTTT channel restrictions in the 15 MHz bandwidth (Figure 11), where blocks in red indicate channels that are barred. Barred channels are indicated by a “No Entry” symbol displayed on the “Spectrum Management” web page, see Section 7.9.11 “Spectrum Management Control with Radar Avoidance”.

Figure 11 - 5.8 GHz UK RTTT Channel Avoidance – 15 MHz Channel Bandwidth (Example)



NOTE

Radar avoidance requirements in the 5.4 GHz band in the EU is detailed in specification EN 301-893 version V1.4.1 plus additional requirements shown in the OJ of the EC and in the US in the specification FCC part 15.407. Radar avoidance at 5.8 GHz is applicable to EU operation and the requirements are currently as defined in EN 302 502.

4.4 Variable Channel Bandwidth Operation

Channel bandwidths of 5, 10 and 15 MHz are supported for the PTP 500 product.

Configuration of the variable bandwidth operation must be symmetric, that is, the Transmit and receive channels must use identical Channel Bandwidths.

For details of the spectrum settings that are available to each frequency variant, refer to:

- Section 16.2.6 PTP 54500 Available Spectrum Settings
- Section 16.3.6 PTP 58500 Available Spectrum Settings

4.5 Link Planning

4.5.1 Link Range

The PTP 500 Series Bridge operates at ranges from 100 m (330 ft) to 250 km (155 miles). Operation of the system will depend on obstacles in the path between the units. Operation at 40 km (25 miles) or above requires a near line of sight path. Operation at 100m (330 ft) may be achieved with one unit totally obscured from the other unit, but with the penalty of transmitting at higher power in a non-optimal direction, thereby increasing interference in the band.

4.5.2 Obstructions

A survey must be performed to identify all the obstructions (such as trees or buildings) in the path and to assess the risk of interference. This information is important if you are to achieve an accurate link feasibility assessment.

4.5.3 PTP LINKPlanner

Link planning enables a link of known quality to be installed. This involves the acquisition of path profile data (using Motorola's free LINKPlanner utility). The LINKPlanner predicts data rates and reliability over the path. It allows the user to try different antenna heights and RF power settings. When the link is installed, the mean path loss can be checked to confirm that the predicted data rate and link reliability is achievable. Motorola LINKPlanner is available to download from http://www.motorola.com/ptp/support.

4.6 Site Selection Criteria

The following are guidelines for selecting the installation location of the ODU and PIDU Plus for a PTP 500 Series Bridge.

4.6.1 ODU Site Selection

When selecting a site for the ODU the following should be taken into consideration:

- It should not be possible for people to stand or walk in front of the antenna
- Height and location to achieve the best radio path
- Height in relation to other objects with regard to lightning strikes
- Aesthetics and planning permission issues
- Distance from the ODU and connected Network equipment (Maximum cable run from the ODU to the connected equipment is 100m [330 ft])
- The effect of strong winds on the installation – see Section 4.7 “Wind Loading”.

4.6.2 PIDU Plus Site Selection

When selecting a site for the PIDU Plus the following should be taken into consideration:

- Availability of a mains electricity supply
- Accessibility for viewing status indicators and pressing Recovery switch.

4.7 Wind Loading

Antennas and electronic equipment mounted on towers or pole mounted on buildings will subject the mounting structure to significant lateral forces when there is appreciable wind. Antennas are normally specified by the amount of force (in pounds) for specific wind strengths.

The magnitude of the force depends on both the wind strength and size of the antenna.

4.7.1 Calculation of Lateral Force

The PTP 500 Series bridge with or without the integral antenna is essentially a flat structure and so the magnitude of the lateral force can be estimated from:

Force (in pounds) = 0.0042 . A . v^2

Where A is the surface area in square feet and v is the wind speed in miles per hour.

The lateral force produced by a single PTP 500 Series bridge (integrated or connectorized model) at different wind speeds is shown in Table 5 and Table 6.

Table 5 - Lateral Force – Imperial

	Largest Surface Area (sq ft)	Lateral Force (Pound) at wind speed (mph)				
		80	100	120	140	150
PTP 500 Series Bridge - Integrated	1.36	36.6	57.1	82.3	146.2	228.5
PTP 500 Series Connectorized	1.00	26.9	42	60.5	107.5	168.0

Table 6 - Lateral Force – Metric

	Largest Surface Area (sq m)	Lateral Force (kg) at wind speed (m/s)				
		30	40	50	60	70
PTP 500 Series Bridge - Integrated	0.130	12	22	34	49	66
PTP 500 Series- Connectorized	0.093	9	16	24	35	48

NOTE

When the connectorized version of PTP 500 Series bridge is used with external antennas, the figures from the antenna manufacturer for lateral force should be included to calculate to total loading on the mounting structure.

4.7.2 Capabilities of the PTP 500 Series Bridges

The structure and mounting brackets of the PTP Series systems are capable of withstanding wind speeds up to 151mph (242 kph). The installer should ensure that the structure to which the PTP 500 Series Bridge is fixed to is also capable of withstanding the prevalent wind speeds and loads.

4.7.3 Wind Speed Statistics

Installers are recommended to contact the national meteorological office for the country concerned to identify the likely wind speeds prevalent at the proposed location. This will enable the installer to estimate the total wind loading on the support structures.

Examples of the sort of statistics that are available are:

USA - Reported Fastest Single Wind Velocities for Selected U.S. Cities

(Source: National Weather Service).

City, State	Wind Velocity (mph)
Bismarck, North Dakota	72
Buffalo, New York	91
Chicago, Illinois	87
Hatteras, North Carolina	110
Miami, Florida	132
New York, New York	99
Pensacola, Florida	114

UK Meteorological Office, www.meto.gov.uk

Peak wind speed contour maps can be found as Fig 3a/3b at:

http://www.meto.gov.uk/education/historic/1987.html

4.8 Path Loss Considerations

Path loss is the amount of attenuation the radio signal undergoes between the two ends of the link.

4.8.1 Calculating Path Loss

The path loss is the sum of the attenuation of the path if there were no obstacles in the way (Free Space Path Loss), the attenuation caused by obstacles (Excess Path Loss) and a margin to allow for possible fading of the radio signal (Fade Margin). The calculation of Equation 2 needs to be performed to judge whether a particular link can be installed.

Equation 2 - Path Loss

$$L_{free\_space} + L_{excess} + L_{fade} + L_{seasonal} < L_{capability}$$

Where

L_{free_space}	Free Space Path Loss (dB)
L_{excess}	Excess Path Loss (dB)
L_{fade}	Fade Margin Required (dB)
$L_{seasonal}$	Seasonal Fading (dB)
$L_{capability}$	Equipment Capability (dB)

4.8.2 Adaptive Modulation

Adaptive Modulation ensures that the highest throughput that can be achieved instantaneously will be obtained, taking account of propagation and interference. When the link has been installed, web pages provide information about the link loss currently measured by the equipment, both instantaneously and averaged. The averaged value will require maximum seasonal fading to be added, and then the radio reliability of the link can be computed.

For minimum error rates on TDM links, the maximum modulation mode should be limited to 64QAM 0.75.

The values for (BPSK) are static receive sensitivity measurements. The other values are static receive sensitivity measurements with an AMOD threshold applied. The AMOD threshold applied is for a benign radio channel.

Field definitions are:

Sensitivity

Sensitivity is defined as the combined receive input signal level on both horizontal and vertical inputs that produces a Null BER Error ratio of $3x10^{-7}$.

Output Power

The output power is for a centre channel in Region 1. The output power will be reduced on the edge channels and may vary if different region codes are selected.

AMOD Threshold

The AMOD threshold is the combined receive input signal level on both horizontal and vertical inputs that results in the link consistently entering the receive modulation mode under consideration as the signal level is increased.

System Threshold

Thresholds for all modes except BPSK are for the relevant link optimization AMOD thresholds. System threshold for BPSK is the RPSK receive sensitivity.

Max Link Loss

The maximum link loss for each modulation mode is derived from the AMOD threshold for that mode (sensitivity threshold for BPSK) and the maximum Region 1 centre channel output power. The figures assume integral antennas are used, with gain 23 dBi (5.8 GHz and 5.4 GHz).

4.9 System Threshold, Output Power and Link Loss

For details of the system threshold, output power and link loss for each frequency variant in all modulation modes for all available channel bandwidths, refer to:

- Section 16.2.7 PTP 54500 System Threshold, Output Power and Link Loss
- Section 16.3.7 PTP 58500 System Threshold, Output Power and Link Loss

5 Lightning Protection

This section provides instructions for protecting PTP 500 installations against lightning strike. The purpose of lightning protection is to protect structures, equipment and people against lightning by conducting the lightning current to ground via a separate preferential solid path.

The following topics are described in this section:

- 5.1 Lightning Protection Zones
- 5.2 LPU Detailed Installation
- 5.3 LPU Kit
- 5.4 LPU Installation Wiring
- 5.5 LPU Installation Diagram

This section should be treated as a guide only. The actual degree of lightning protection required depends on local conditions and weather patterns and applicable local regulations. Full details of lightning protection methods and requirements can be found in the international standards IEC 61024-1 and IEC 61312-1, the U.S. National Electric Code ANSI/NFPA No. 70-1984 or section 54 of the Canadian Electric Code.

⚠ CAUTION

EMD (Lightning) damage is not covered under standard warranty. The recommendations in this user manual, when implemented correctly, give the user the best protection from the harmful effects of EMD. However 100% protection is neither implied nor possible.

5.1 Lightning Protection Zones

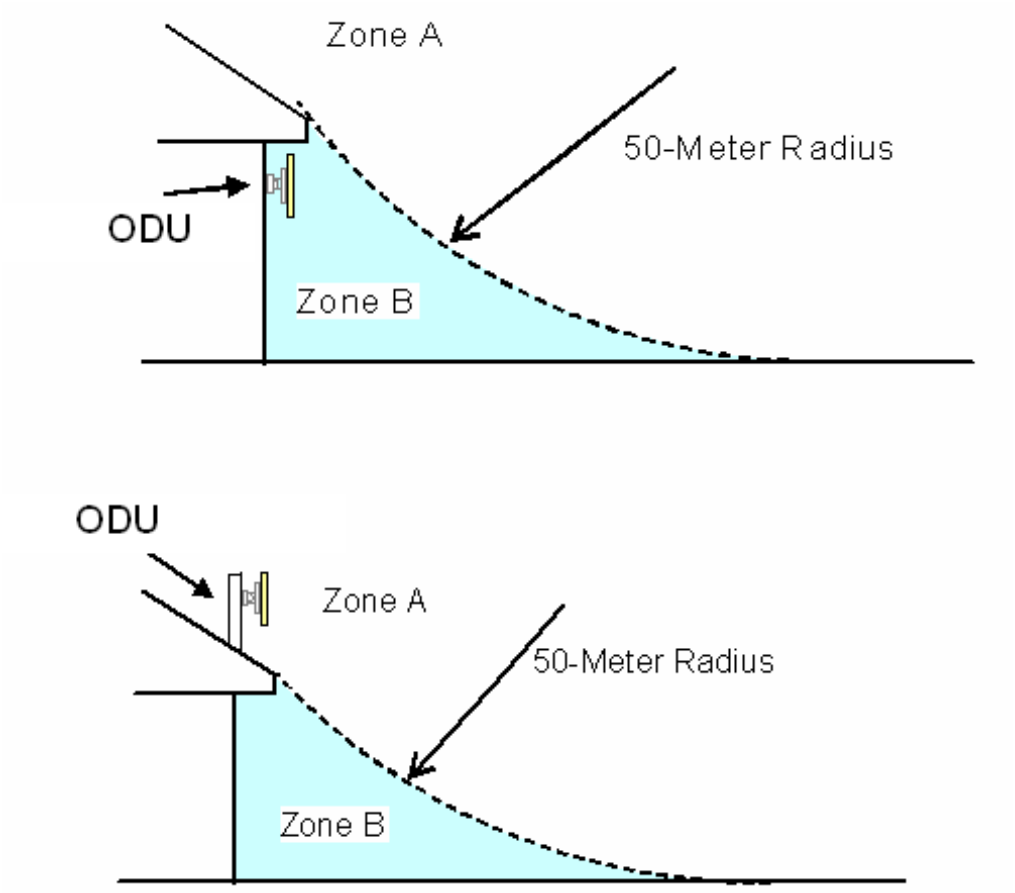
When the ODU is installed on a mast, tower or wall, it may be in one of two possible lightning protection zones :

- Zone A: In this zone a direct lighting strike is possible. Do not mount the ODU in this zone.
- Zone B: In this zone, direct EMD (Lightning) effects are still possible, but mounting in this zone significantly reduces the possibility of a direct strike. Mount the ODU in this zone.

The zones are determined using the ‘rolling sphere method’: an imaginary sphere, typically 50 meter in radius, is rolled over the structure. All structure points that contact the sphere indicate the zone (A) where a direct strike is possible. Similarly points that do not contact the sphere indicate a zone (B) where a direct strike is less likely.

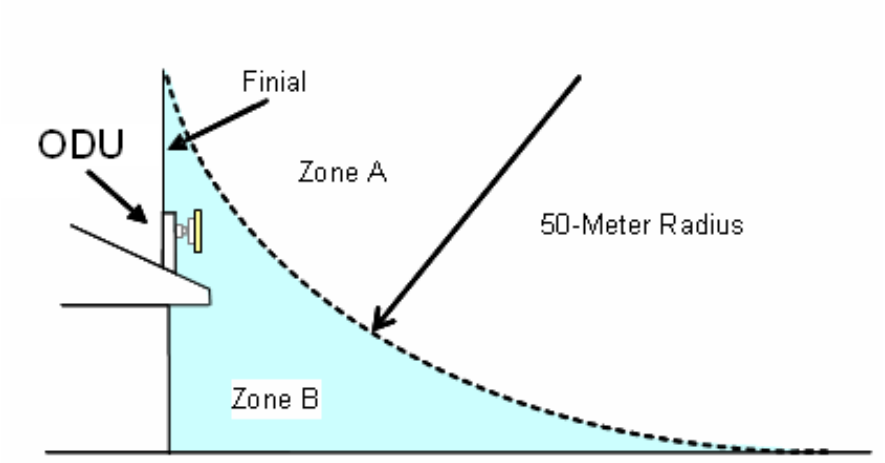
Zones A and B are shown in Figure 12.

Figure 12 - ODU mounted in Zones A & B



It may be possible to extend Zone B by installing a finial above the ODU (Figure 13).

Figure 13 – Using a Finial to Extend Zone B



In Zone B, a direct lightning strike is unusual, but the un-attenuated electromagnetic field is still present. Equipment mounted in Zone B should be grounded using grounding wire of at least 10 AWG. This grounding wire should be connected to a grounding rod or the building grounding system before entry in to building.

NOTE

Local regulations may also require the fitting of the 8 AWG grounding wire.

WARNING

Equipment mounted in Zone A must be capable of carrying the full lightning current. Mounting of the ODU in Zone A is not recommended. Mounting in Zone A should only be carried out observing the rules governing installations in Zone A. Failure to do so may put structures, equipment and life at risk.

The PTP 500 Series bridge ODU grounding point can be found on the bottom of the unit. The ODU is supplied with an appropriate grounding lug.

The following protection requirements are mandatory in both Zones A and B:

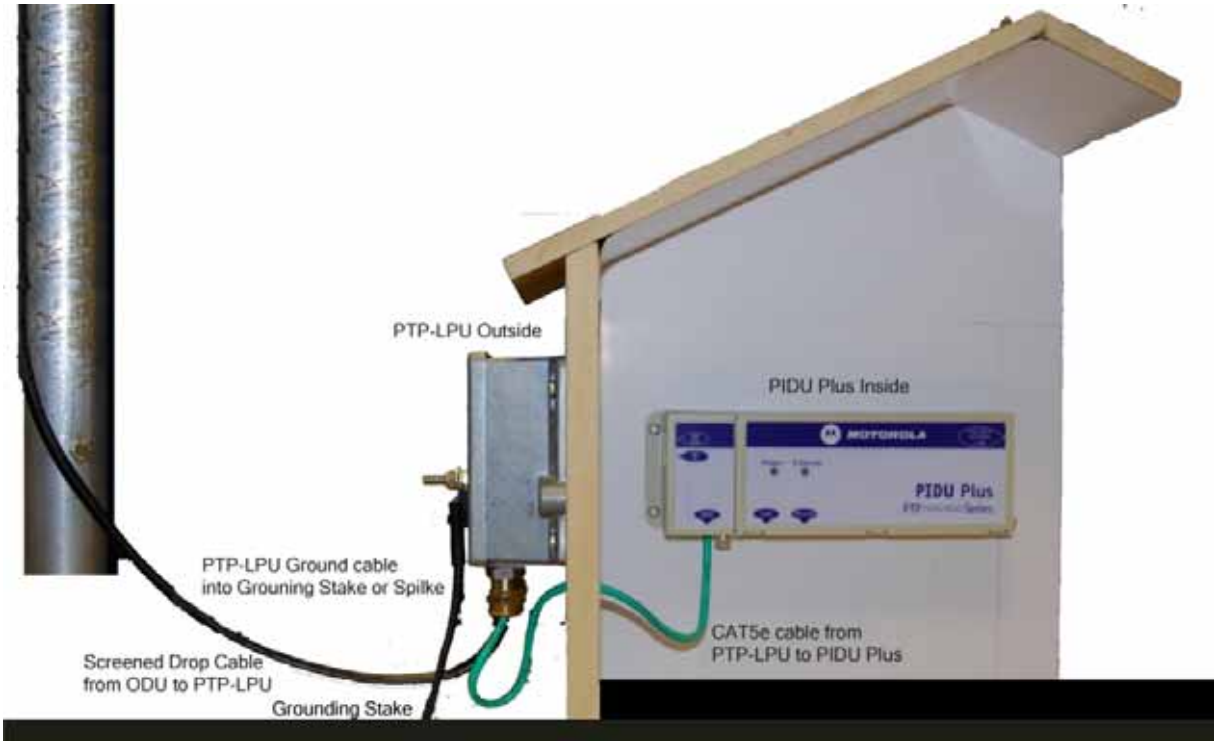
- The ODU must be earthed
- Screened CAT 5e cable must be used
- Surge arrestors of type PTP-LPU must be installed at building entry
- There must be an earth connection at building entry

The recommended standard components for protecting installations are listed in 5.5 “LPU Installation Diagram”.

5.2 LPU Detailed Installation

The Lightning protection Unit should be mounted at the building entry point and must be grounded (Figure 14).

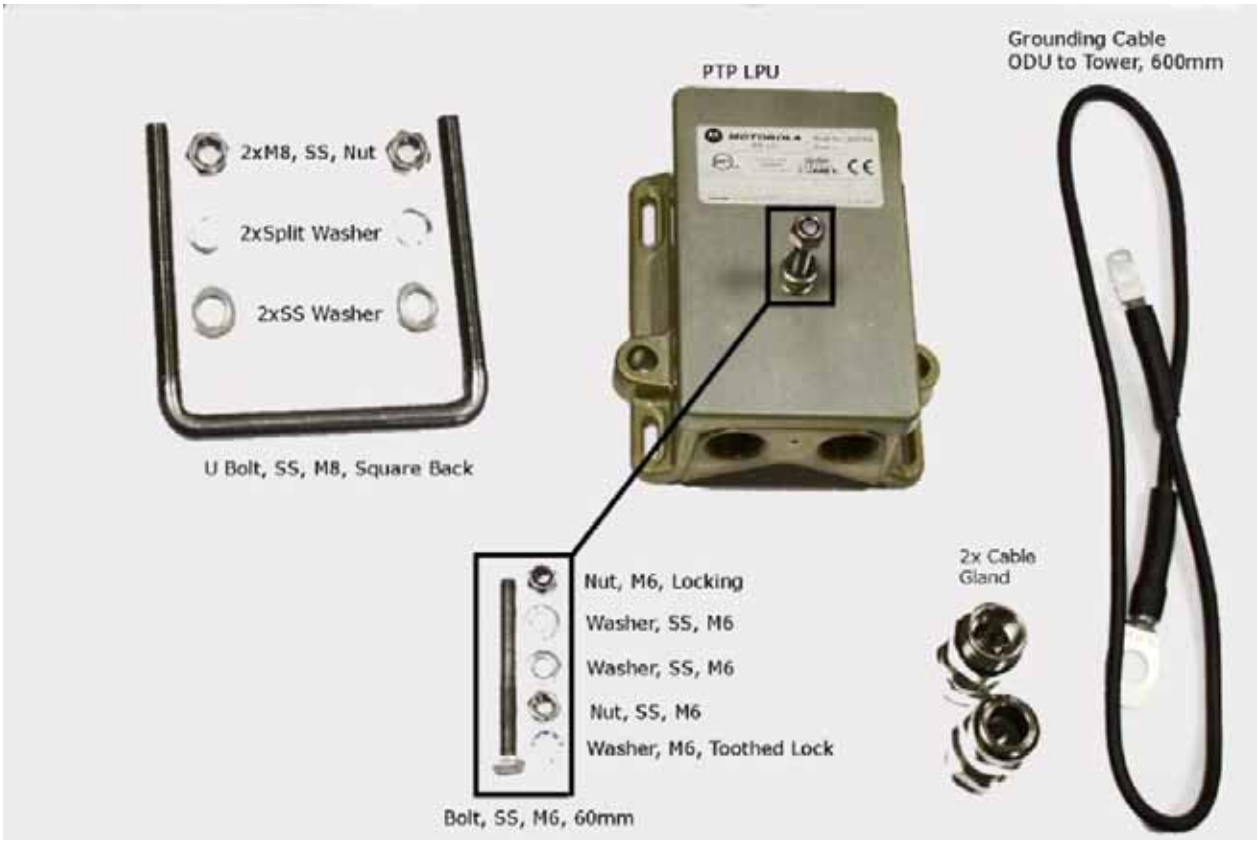
Figure 14 – PTP LPU Installation Example for PTP 500 Series (Not to Scale)



5.3 LPU Kit

The PTP-LPU Kit is supplied with a 600mm ODU to PTP-LPU cable pre-fitted with glands. Figure 15 shows all the components that are supplied with the Motorola Kit WB2978AA.

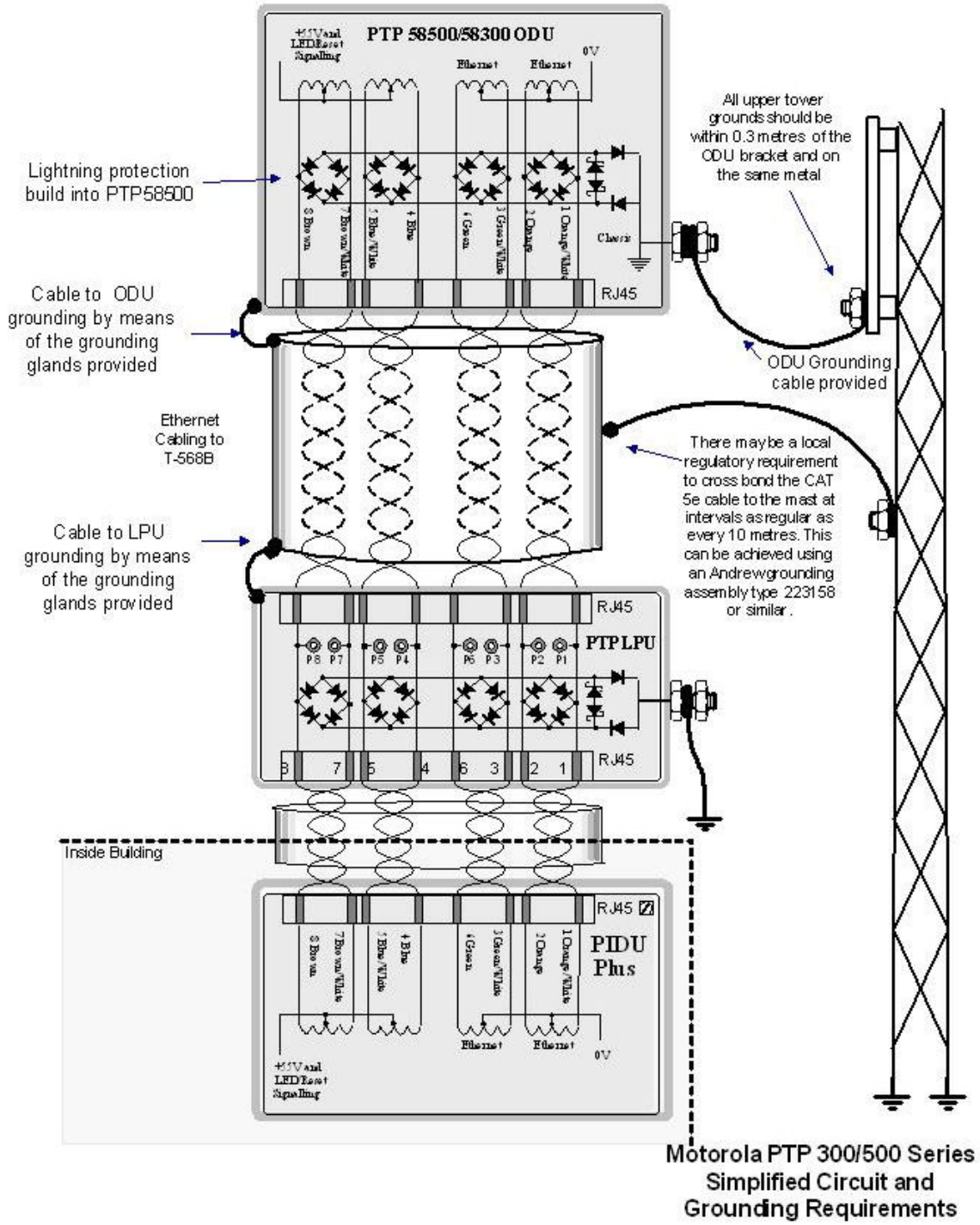
Figure 15 - PTP LPU Full Kit



5.4 LPU Installation Wiring

Figure 16 shows the correct installation wiring for a PTP 500 with lightning protection.

Figure 16 - Simplified Circuit Diagram



5.5 LPU Installation Diagram

This section contains a diagram to show how the components of PTP 500 sites are installed and connected with LPU.

The recommended standard components for protecting installations are:

- Screened CAT 5e cable, also known as Shielded CAT 5e or CAT 5e STP (Shielded Twisted Pair)
- Surge arrestor, type PTP-LPU: 2 per link (1 Motorola Kit Part Number WB2978AA)
- Grounding stake
- Grounding cable: minimum size 8 AWG, preferably 6 or 4 AWG
- RJ45 screened connectors

There may be a local regulatory requirement to cross bond the CAT 5e cable to the mast or tower at intervals as regular as every 10 metres (33 feet). This can be achieved using an Andrew grounding assembly type 223158 or similar.

NOTE

Refer to instructions contained in the Andrew grounding kit for correct installation, or if instructions are missing, refer to:

http://awapps.commscope.com/catalog/product_details.aspx?id=15832&tab=2

Where an installation already has, or requires the use of a Master Ground Bar then the requirements of Motorola Specification R56 "STANDARDS AND GUIDELINES FOR COMMUNICATION SITES" (68P81089E50) take precedence over those in this guide.

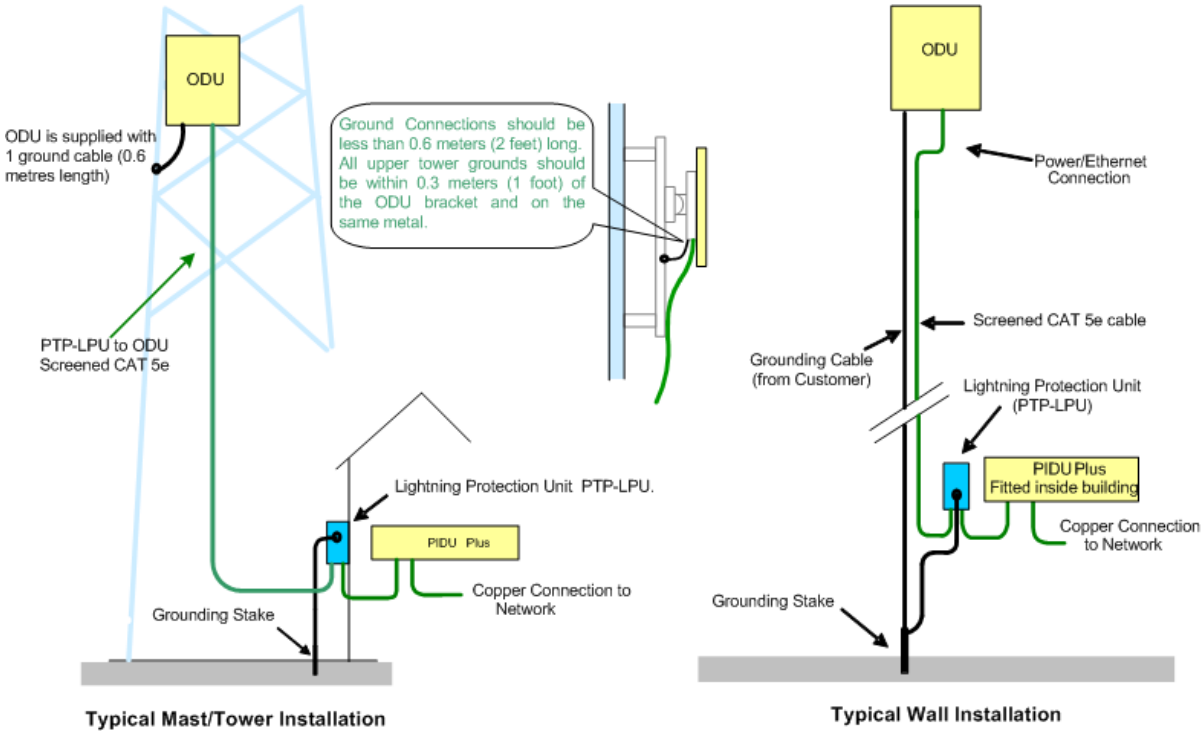
NOTE

If a coaxial (or other) cable is already cross-bonded to the mast or tower, the same cross bonding points on the mast or tower must be used for the CAT 5e cable.

5.5.1 Typical Mast or Wall Installation

Figure 17 shows a typical PTP 500 Series mast or wall installation using PTP-LPU Surge protection.

Figure 17 - Typical Mast or Wall Installations



6 Installation

This section provides instructions for installing a PTP 500 link.

It is advised that the link be configured and tested on a bench before the final installation of the units on site. Providing it is safe to do so, the installer should take the bench testing process to the point where a radio link is established. For more information, see the *Deployment Guide*.

⚠ CAUTION

Motorola recommends that only qualified personnel undertake the installation of a PTP 500 Series Bridge solution.

We recommend that the practices and procedures detailed in the Motorola manual R56 "STANDARDS AND GUIDELINES FOR COMMUNICATION SITES" (68P81089E50) be applied to all new site build activities. This manual is provided on the PTP 500 CD-ROM.

The standard PTP 500 Series installation procedure consists of the following stages:

1. Prepare for installation as described in Section 6.3 “Preparation”.
2. Mount the ODUs as described in Section 6.4 “Mounting the ODUs”.
3. Connect the equipment as described in Section 6.5 “Connecting Up”.
4. Establish a radio link as described in Section 6.6 “Establishing a Radio Link”.

Depending upon the options required, see also the following sections:

1. If a connectorized PTP 500 variant is to be installed, see Section 10 “Connectorized PTP 500 Series Bridge”.
2. If an E1/T1 link is to be installed, see Section 11 “E1/T1 Installation Guide”.
3. If the link is to be encrypted, see Section 13 “AES Encryption”.

6.1 Installation Support

Online installation support and contact details for your regional support can be found at http://www.motorola.com/ptp

A Frequently Asked Questions (FAQ) section can be found in Section 17 “FAQs”.

6.2 Legal Disclaimer

IN NO EVENT SHALL MOTOROLA, INC. BE LIABLE FOR ANY INJURY TO ANY PERSONS OR ANY DAMAGE CAUSED DURING THE INSTALLATION OF THE MOTOROLA PTP 500 SERIES PRODUCT.

6.3 Preparation

6.3.1 Checks

Before proceeding with the installation, perform the following checks:

- Ensure that you have planned the link, as described in Section 4 “Planning Considerations”.
- Check the contents of all packages against the parts lists shown in the packing list.
- Ensure that you are qualified to undertake the work.
- Ensure that you have taken the correct safety precautions.

6.3.2 Tools Required

The following specific tools are required to install a PTP 500 Series Bridge, in addition to general tools:

- 13mm wrench and 22 mm wrench for use with the glands
- RJ45 crimp tool (it must be the correct tool for the type of RJ45 being used)
- Personal Computer (PC) with 100BaseT Ethernet
- Either Internet Explorer version 6 or higher, or FireFox 2.0 or higher are recommended.
- Ethernet patch cables
- Motorola PTP LINKPlanner report for this link

6.4 Mounting the ODUs

6.4.1 Mounting Bracket

The ODU is pre-fitted with a mounting bracket (designed to ease installation) and an earth bonding lead (Figure 18).

Figure 18 – ODU with Mounting Bracket and Earth Bonding Lead



6.4.1.1 Safety Precautions When Mounting the ODU

⚠ WARNING

To prevent failure of the assembly, observe the precautions listed below when mounting the ODU.

The following safety precautions must be taken when mounting the ODU:

- Do not remove the pre-fitted mounting bracket from the ODU.
- Do not mount the ODU on poles with diameter less than 50mm (2”) or greater than 75mm (3”). The ODU mounting bracket is designed to work only with poles with diameter in the 50 mm (2”) to 75 mm (3”) range.
- Do not over-tighten the bolts.

6.4.2 ODU Mounting Procedure

The ODU must be mounted using the following steps, ensuring that the cable entry is at the bottom:

1. Attach the bracket strap to the pole using M8 x 70 mm bolts, M8 flat washers and M8 coil washers (Figure 19). Tighten to ensure the assembly grips but can be adjusted.

Figure 19 – ODU Bracket Strap



2. Offer the ODU (with pre-fitted mounting bracket) to the bracket strap and affix using the captive M8 bolt. Tighten to ensure the assembly grips, but can be adjusted on the pole (Figure 20 and Figure 21).

Figure 20 – ODU Mounting Bracket

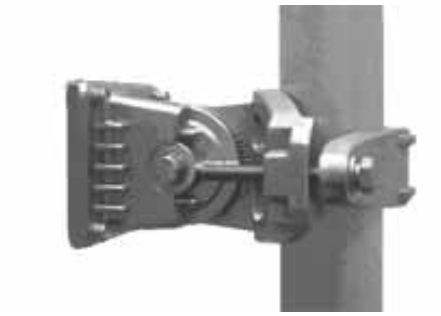


Figure 21 - ODU Mounted on Pole



3. Adjust the elevation and azimuth of the unit before tightening to the required torque settings of 14 Nm (11 lb ft) for both bolts.

⚠ CAUTION

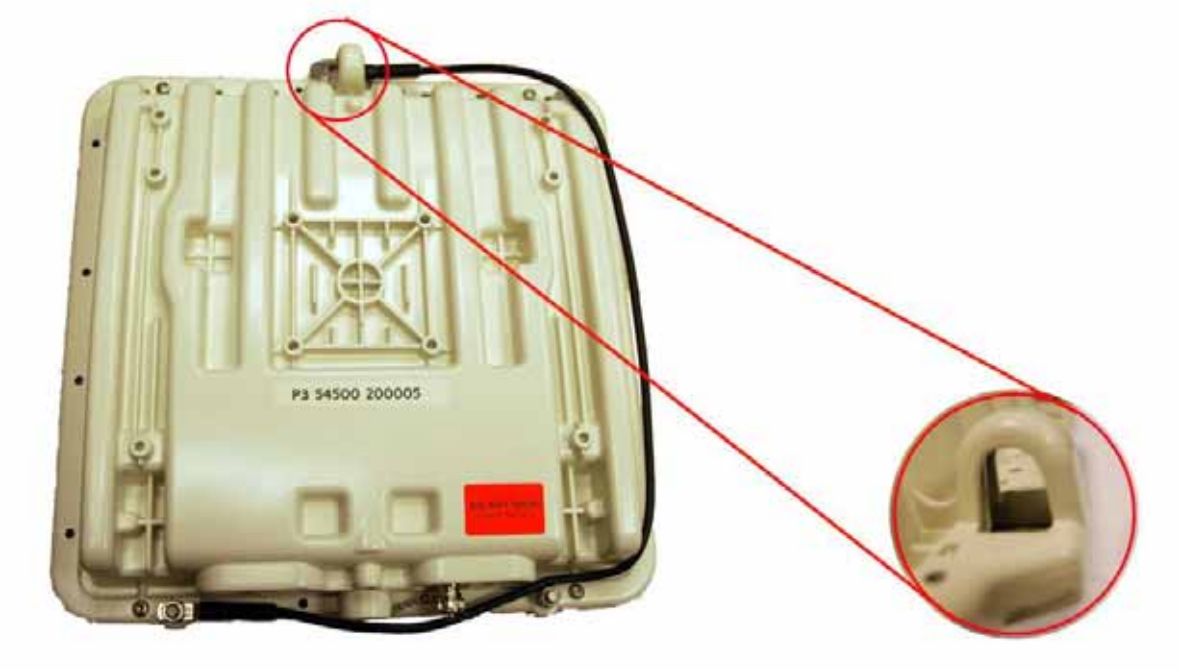
Attach the free end of the earth bonding lead (large tag M10) to the tower metal work. On no account must this be attached to the mounting bracket bolts.

The enclosure and mounting brackets of the PTP 500 Series Bridge product range are capable of withstanding wind speeds up to 200 mph (320 kph). The installer should ensure that the structure the bridge is fixed to is also capable of withstanding the prevalent wind speeds and loads. See Section 4.7 “Wind Loading”.

6.4.3 Hoist and Safety Loop

Use the integral safety loop (Figure 22) for hoisting the ODU up a mast, tower or building. When the ODU is in position, use the safety loop as a fixing point to secure a permanent lanyard from the mast, tower or building to the ODU, as a precaution against mounting failure.

Figure 22 - Integral Safety Loop



⚠ WARNING

The safety lanyard must not exceed 1m (approx 3 ft) in length. The lanyard must be made from a material that does not degrade in an outdoor environment.

The safety lanyard must be fixed to a separate fixing point that is not part of the direct mounting system for the ODU.

If the safety loop or its fixing is damaged in any way or has been exposed to a shock loading due to a fall, replace it with a new one before undertaking any further operations.

6.5 Connecting Up

6.5.1 Preparing the PIDU Plus To ODU Cable

The maximum cable length between the ODU and the user's Network Equipment is 100m (330 ft). Cable lengths up to 300m (984 ft) can be used where the PIDU Plus to ODU cable is supplying power only, that is, when using the PTP 500 Series Bridge Optical Interface.

6.5.1.1 Cable Safety Precautions

⚠ WARNING

The copper screen of the recommended Superior Essex cable is very sharp and may cause personal injury. When preparing the Superior Essex cable, take the following safety precautions:

ALWAYS wear cut resistant gloves (check the label to ensure they are cut resistant).

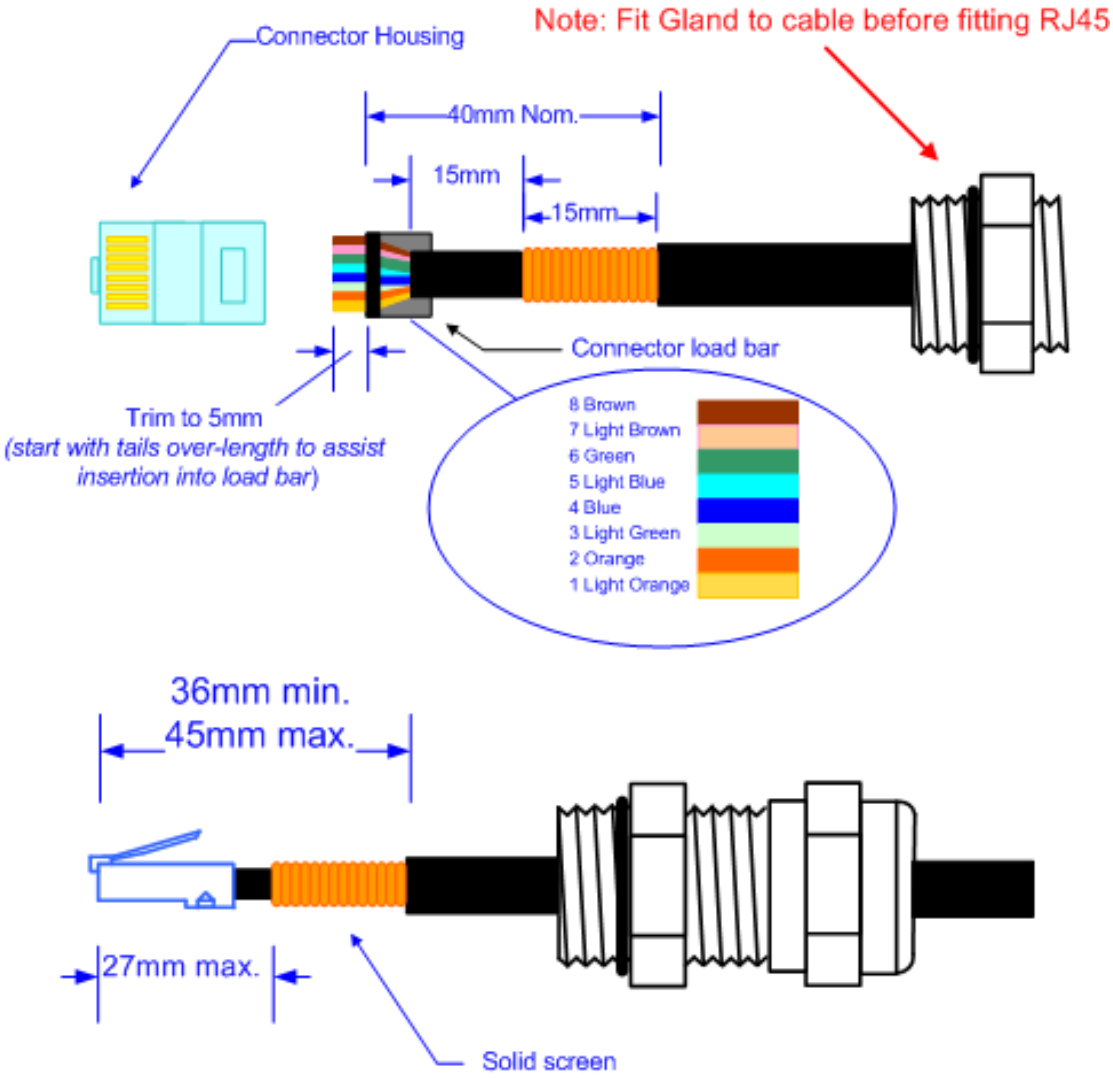
ALWAYS wear protective eyewear.

ALWAYS use a rotary blade tool to strip the cable (DO NOT use a bladed knife). To use the rotary blade tool, fit it around the outer cable sheaf and rotate the cutter around the cable once or twice. The stripped outer section can then be removed.

6.5.1.2 Cable Assembly

The cable should be assembled as shown in Figure 23:

Figure 23 - Correct Cable Preparation for the Recommended Cable



Cable Type;	Superior Essex, BBDGE CAT5e
Connector Type;	Tyco (AMP), 5-569278
Crimp Tool;	Tyco (AMP), 2-231652; Die set 1-853400-0
Gland;	Motorola WB1811

⚠ CAUTION

Check that the crimp tool matches the RJ45 connector being used.

Both ends of the ODU cable are terminated in the same way. The above procedure should be repeated for the PIDU Plus end of the cable when the cable routing process is complete. This assumes that the installation uses PTP LPUs. If not, then the PIDU Plus end of the cable does not require a Gland, but just the RJ45.

NOTE

The PIDU Plus end of the cable does not employ a cable gland.

Figure 24 shows a completed ODU to PIDU Plus cable.

Figure 24 - Completed ODU Connector



⚠ CAUTION

Do not over tighten the glands as the internal seal and structure may be damaged. See Figure 25 for an example of an over tightened cable gland.

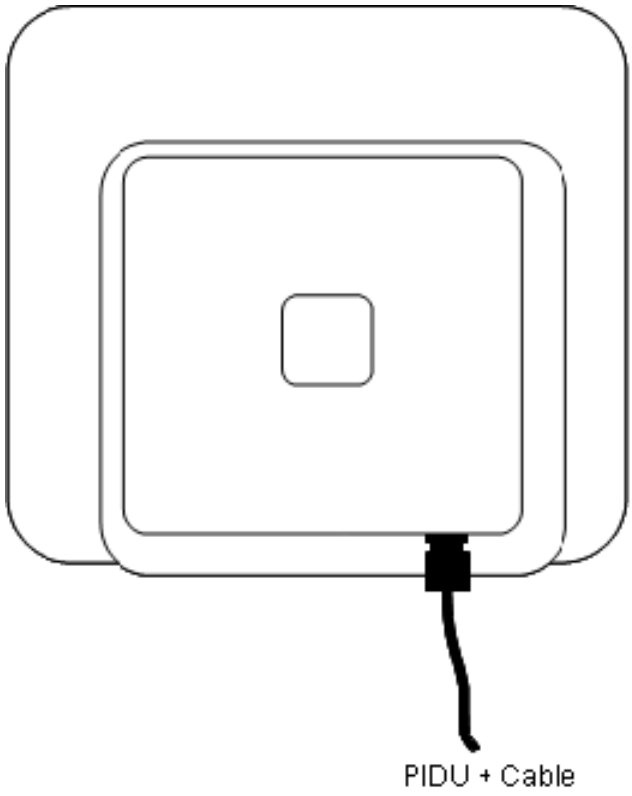
Figure 25 - Correct and Incorrect Tightening of Cable Gland



6.5.2 Making the Connections at the ODU

Looking at the back of the unit with the cable entry at the bottom, the PIDU Plus connection is the first hole on the right (Figure 26) and is labeled “PIDU Plus +”.

Figure 26 – ODU PIDU Plus Connexion



6.5.3 Making the PIDU Plus Connection At The ODU

The procedure for connecting the PIDU Plus cable to the ODU is described in Figure 27. It is often easier to carry out this procedure on the ground or a suitable surface prior to mounting the ODU.

Ensure that no power is connected to the PIDU Plus or present on the cable before connecting the ODU.

Figure 27 - Connecting the PIDU Plus to the ODU

<table>
<tr>
<td> 
Step 1: Assemble the cable as described in 6.5.1 above</td>
<td> 
Step 2: Insert the RJ45 connector making sure that the locking tab snaps home</td>
</tr>
<tr>
<td> 
Step 3: Screw in the body of the weather proofing gland and tighten</td>
<td> 
Step 4: Screw on the clamping nut and tighten (Do not over tighten – see Figure 25)</td>
</tr>
</table>

Should it be necessary to disconnect the PIDU Plus to ODU cable at the ODU, this can be achieved by removing the weather proofing gland and depressing the RJ45 locking tab with a small screwdriver as shown below.

Figure 28 - Disconnecting the ODU



⚠ CAUTION

To prevent damage to the ODU while making or breaking the connection, ensure that power is removed from the system at the PIDU Plus.

6.5.4 Routing the Cable

After connecting the cable to the ODU it can be routed and secured using standard cable routing and securing techniques. When the cable is in place it can then be cut to the desired length at the PIDU Plus prior to connection to the PIDU Plus.

6.5.5 Fitting a Lightning Protection Unit

If you have opted to fit a Lightning Protection unit, this should be installed by following the manufacturer's instruction. For recommended types see Section 5 "Lightning Protection".

6.5.6 Grounding the Installation

The Outdoor Unit (ODU) must be properly grounded to protect against power surges. It is the user's responsibility to install the equipment in accordance with Section 810 of the National Electric Code, ANSI/NFPA No.70-1984 or Section 54 of the National Electrical Code in the country of installation. These codes describe correct installation procedures for grounding the outdoor unit, mast, lead-in wire and discharge unit, size of grounding conductors and connection requirements for grounding electrodes. It is recommended that installation of the outdoor unit be contracted to a professional installer.

6.5.7 Making the ODU Connection at the PIDU Plus

The procedure for connecting the RJ45 from the ODU to the PIDU Plus is described in Figure 29. The ODU is connected to the PIDU Plus by means of a concealed RJ45 connector. The RJ45 connection has been placed inside the PIDU Plus hinged cover to prevent the user from inadvertently plugging other equipment into the ODU RJ45 socket.

⚠ CAUTION

Plugging other equipment into the ODU RJ45 socket may damage the equipment due to the non-standard techniques employed to inject DC power into the 100BaseT connection between the PIDU Plus and the ODU. Plugging the ODU into other equipment may damage the ODU and/or the other equipment.

Figure 29 - Connecting the ODU to the PIDU Plus



Step 1: Undo the retaining screw and hinge back the cover.



Step 2: Plug in the ODU into the PIDU Plus Cable ensuring that it snaps home.



Step 3: Replace the cover and secure with the retaining screw.

6.5.8 Making the Network Connection at the PIDU Plus

The Network connection is made by connecting the user's Network Equipment directly to the PIDU Plus LAN port as shown in Figure 30.

Figure 30 - Making the Network Connection at the PIDU Plus



6.5.9 Mounting the PIDU Plus

Motorola recommends that you mount the PIDU Plus on a wall or other suitable mounting surface (but this is optional. This prevents the unit from being knocked or kicked and can help maintain link availability. Ensure that the Recovery switch can be accessed when mounting the unit.

The procedure for mounting the PIDU Plus is described in Figure 31.

Figure 31 - Mounting the PIDU Plus



Step 1: Fix the PIDU Plus to the wall using the lugs provided.

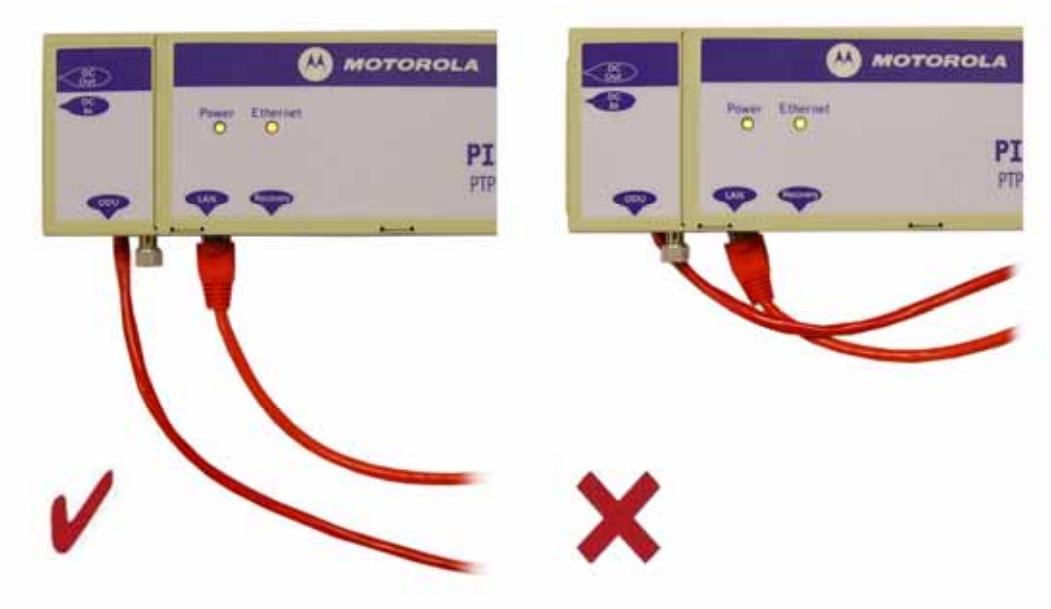


Step 2: Make connections as per Section 6.5.7 “Making the ODU Connection at the PIDU Plus”

⚠ CAUTION

Do not dress the RJ45 cables too tightly, as this may make the connections unreliable. Figure 32 shoes the correct and incorrect ways to dress RJ45 cables when connected to the PIDU Plus.

Figure 32 - Correct and Incorrect RJ45 Cable Dressing

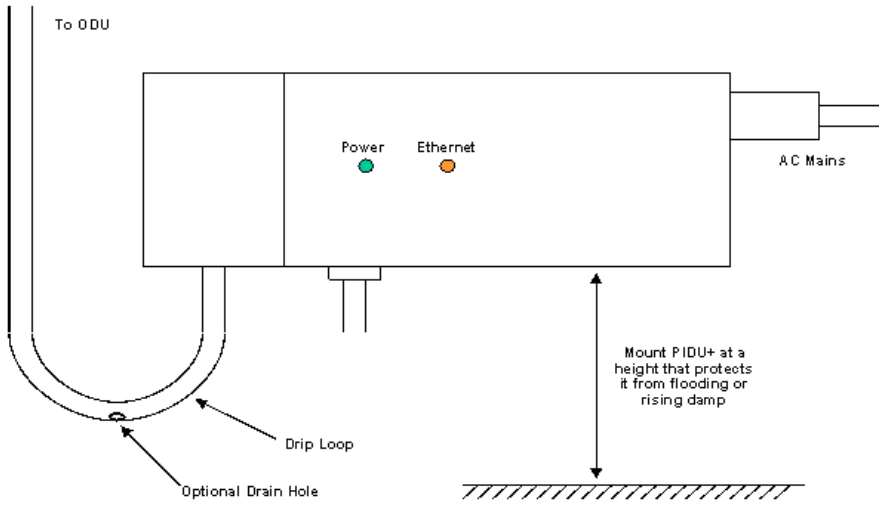


⚠ CAUTION

The PIDU Plus is not waterproof and should be mounted away from sources of moisture. If mounted outdoors, the unit should be mounted in a rain proof enclosure, preferably ventilated.

It is also recommended that you fit a drip loop on the PIDU Plus to ODU cable to ensure that any moisture that runs down the cable into the cabinet or enclosure cannot enter the PIDU Plus. This is shown in Figure 33. The network connection and mains cable should be treated in the same way if there is a risk that they can carry moisture to the PIDU Plus.

Figure 33 – PIDU Plus Drip Loop Configuration



⚠ CAUTION

It is possible for moisture to enter the cable due to damage to the outer protective layer. This moisture can track down the inside of the cable, filling up the drip loop and eventually finding its way into the PIDU Plus. To protect against this the outer protective layer of the cable can be opened up at the bottom of the drip loop to allow this moisture to escape.

6.5.10 Powering Up

The PTP 500 Series Bridge is supplied as a pair of matched Master/Slave units. The Master unit can now be powered up and accessed using the default URL http://169.254.1.2/; the Slave unit can be accessed using http://169.254.1.1/.

Prior to powering up the PTP 500 Series Bridge, a computer with web browsing capabilities should be configured with an IP address of 169.254.n.n and subnet mask of 255.255.0.0 where n is any value between 1 and 254 but excluding 1.1 or 1.2. If the default addresses of the unit 169.254.1.1/2 clashes with an address you are already using on your LAN, or you are not sure, you should set up an isolated LAN. As the LAN connection presented at the PIDU Plus has a default configuration as a hub/switch (and auto-sensing MDI/MDIX cross over is employed), connection can be made directly to the computer using a standard CAT 5 patch cable.

NOTE

It is possible that some units may not be accessed using the above default URL. This is because these units may have been previously configured with IP addresses 10.10.10.11 (Master) and 10.10.10.10 (Slave). Therefore, users must use the URL http://10.10.10.10/ and/or URL http://10.10.10.11/ to configure the units. Please ensure that a computer with web browsing capabilities is configured with an IP address of 10.10.10.n, where n is any value between 2 and 254 but excluding 10 and 11, to configure these units.

6.6 Establishing a Radio Link

The following is a description of the steps taken to establish a radio link between the two units forming the bridge and align the units for the best signal strength.

6.6.1 Aligning the PTP 500 Series Bridge ODUs

The PTP 500 Series Bridge uses audible tones during installation to assist the installer with alignment. The installer should adjust the alignment of the ODU in both azimuth and elevation until highest pitch tone is achieved.

The pitch of the alignment tone is proportional to the received power of the wireless signals. The best results are usually achieved by making small incremental movement in angular alignment.

The tones and their meanings are as follows:

Table 7 - Audio indications from the ODU

State Name	Tone Description	State Description	Pitch Indication (Higher pitch = higher power)
Free Channel Search	Regular beep	Executing band scan	N/A
Scanning	Slow broken tone	Not demodulating the wanted signal	Rx Power
Synchronized	Fast broken tone	Demodulating the wanted signal	Rx Power
Registered	Solid tone	Both Master and Slave units exchanging Radio layer MAC management messages	Rx Power
Alarm	Fast broken dual tone	A fatal error has occurred.	

The term ‘wanted signal’ refers to that of the peer unit being installed.

In each of the states detailed above, the unit should be aligned to give the highest pitch tone. It should be noted that if, when in the Synchronized or Registered state, the tone varies wildly, you may be suffering from interference or a fast fading link. Installing in this situation may not give a reliable link. The cause of the problem should be investigated.

For the ease of alignment, both Master and Slave units use the install tones in the same way but with some small behavioral differences. This allows the installer to install the Slave unit first and carry out the initial alignment with the Master unit if desired. However, due to the behavioral differences of Master and Slave units, it is recommended that the Master unit is installed first and the initial alignment carried out at the Slave unit.

Once the optimum performance has been achieved by directing the Slave unit (indicated by highest frequency of tone) then adjustment of the direction of the Master unit should be done without moving the Slave. Repeat if necessary at the Slave and then the Master until optimum alignment has been obtained.

There is a graphical installation screen (section 7.7.7 “Graphical Install”) available using the web interface that displays the state of the link during the alignment process (up = green, down = red).

6.6.2 Behaviour During Installation

The following behavior should be noted:

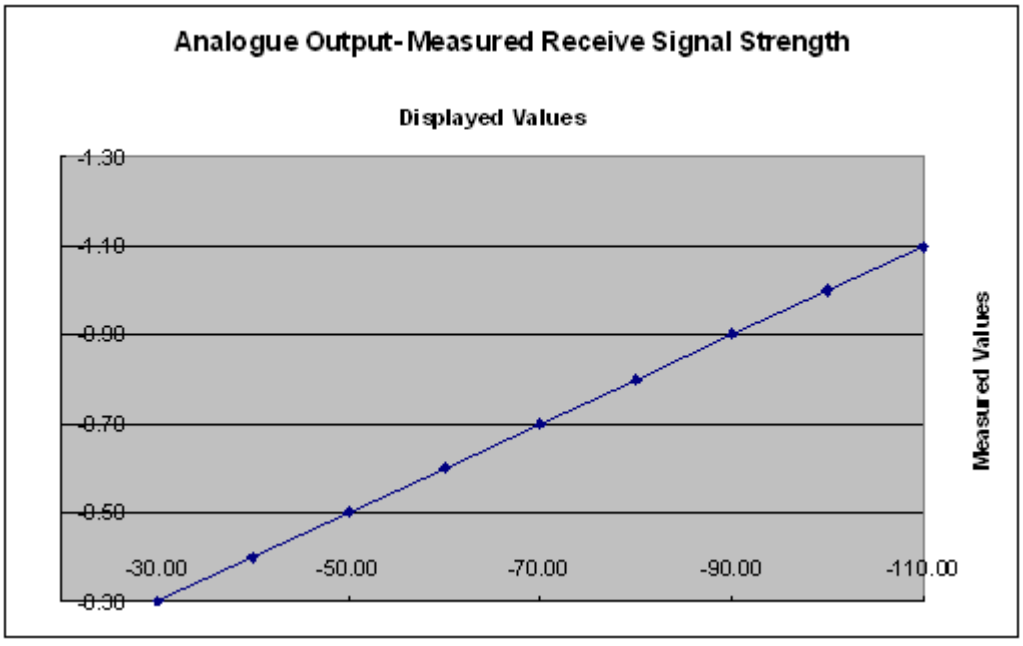
- **Band scan:** When first started up and from time to time, the Master unit will carry out a band scan to determine which channels are not in use. During this time, between 10 and 15 seconds, the Master unit will not transmit and as a consequence of this neither will the Slave unit. During this time the installation tone on the master unit will drop back to the band scan state, and the Slave unit will drop back to the Scanning state with the pitch of the tone set to the background noise level. Alignment of the unit should cease during this time.
- **Radar detection:** If the unit is operating where mandatory radar avoidance algorithms are implemented, the ranging behaviour for the bridge may be affected. The Master has to monitor the initially chosen channel for 60 seconds to make sure it is clear of radar signals before transmitting. If a radar is detected during any of the installation phases, a further compulsory 60 seconds channel scan will take place as the master unit attempts to locate a new channel that is free of radar interference.

- **Ranging:** The PTP 500 Series does not require the user to enter the link range. The Master unit typically takes less than 60 seconds to determine the length of the link being installed. The Master unit will remain in the Scanning state until the range of the link has been established. The Master unit will only move to the Synchronized state when the range of the link has been established.
- **Retrying same channel:** If, at the end of the ranging period, the Registered state is not achieved due to interference or other reasons, the Master unit will retry twice more on the same channel before moving to another available channel. Should this occur it might take a number of minutes to establish a link in the Registered state.
- **Slave unit:** The Slave unit does not have a ranging process. The slave unit will change to the Synchronized state as soon as the wanted signal is demodulated.

6.6.3 DVM Alignment

It is possible to use the BNC connector on the PTP 500 Series ODU and a digital voltmeter (DVM) to help with the alignment process. The BNC connector provides an analogue voltage which is proportional to the receive signal strength. To use, remove the protective cap from the case mounted BNC connector and connect a DVM. You may have to invert the pole for correct reading. Figure 34 shows the relationship between measured values and the receive signal strength.

Figure 34 - Using DVM For Alignment



6.6.4 Adjust Power Settings

The transmit power levels of the installed units must be adjusted to ensure they are not too high. Excessive power levels may cause saturation of the receivers or false radar detection (in radar enabled regions), leading to degradation of link performance and link failure.

To adjust power levels, follow this procedure:

1. Consult the report generated by the LINKPlanner tool and note the Transmit power recommended levels.
2. Set the local unit power equal to the “LOCAL - Max Transmit Power setting while pointing” value from the LINKPlanner report.
3. Set the remote unit power equal to the “REMOTE - Max Transmit Power setting while pointing” value from the LINKPlanner report.
4. Access each unit separately.
5. Align the units.
6. Repeat Step 2 and 3 using the values “LOCAL - Max Transmit Power setting before disarm” and “REMOTE - Max Transmit Power setting before disarm” , if different than the corresponding “while pointing” values.
7. Reboot the local unit then reboot the remote unit.
8. Disarm the units.

6.6.5 Disarm on Completion

When the alignment process is complete, the installer MUST REMEMBER TO DISARM BOTH UNITS in the link, as described in Section 7.7 “Installation Wizard”. This is necessary in order to:

- Turn off the audible alignment aid (section 7.7.6 “Disarm”)
- Enable Adaptive Modulation
- Fully enable Advanced Spectrum Management with i-DFS
- Clear unwanted installation information from the various systems statistics
- Store the link range for fast link acquisition on link drop
- Enable higher data rates

NOTE

After 24 hours, the units will be disarmed automatically, provided that they are armed and that the link is UP.

7 Web Page Reference

This section describes the PTP 500 web user interface and provides instructions for operators.

The following topics describe the menu navigation bar and main menu options:

- 7.1 Menu Navigation Bar
- 7.2 Home (System Summary)
- 7.3 System Status
- 7.4 System Administration

The following topics describe the System Administration menu options:

- 7.5 Configuration
- 7.6 Statistics
- 7.7 Installation Wizard
- 7.8 Software Upgrade
- 7.9 Spectrum Management
- 7.10 Remote Management
- 7.11 Diagnostics Plotter
- 7.12 Change Password
- 7.13 License Key
- 7.14 Properties
- 7.15 Reboot

NOTE

The web pages are best viewed using a screen resolution of at least 1024 x 768 pixels on a PC using Microsoft Internet Explorer Version 6 or 7.

The web pages have also been tested with Firefox 2.0.0.12. Other browsers have not been tested.

7.1 Menu Navigation Bar

The navigation bar on the left hand side of the web page is used to move between the various management pages. The currently selected page is always highlighted with a light blue background. The menu is hierarchical. Selecting a menu item which has associated submenu options will automatically display all sub options. A sample web page with the navigation menu is shown in Figure 35.

Figure 35 - Menu Navigation Bar



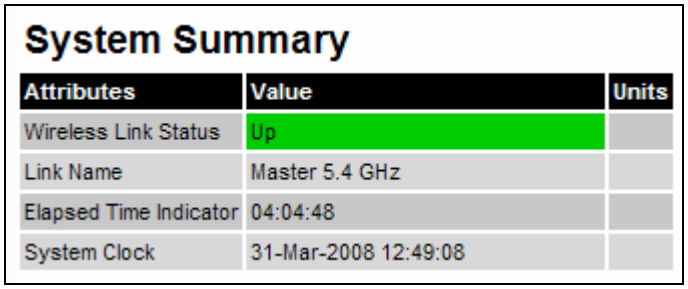
The web user interface menu has three main options.

- **Home:** This presents to the operator a high level summary of the PTP 500 Series Bridge point-to-point wireless link.
- **Status:** This presents a more detailed set of system parameters describing the performance of the wireless link together with other key system performance metrics.
- **System Administration**: This section is password protected and allows the system administrator to perform all the day-to-day administrative procedures, for example software upgrade and configuration changes.

7.2 Home (System Summary)

The home page for the PTP 500 Series Bridge (Figure 36) displays a high level summary of the status of the wireless link and associated equipment.

Figure 36 - System Summary Page



The home page normally displays four key system attributes:

Wireless Link Status

The Wireless Link Status attribute displays the current status of the PTP 500 Series Bridge wireless link. A state of 'Up' on a green background indicates that a point-to-point link is established. A state of 'Down' on a red background indicates that the wireless link is not established. If the link is down for an unknown reason the system administrator should first consult the status web page for a more detailed summary of up to date system diagnostics.

Link Name

The link name attribute is a name and/or handle allocated by the system administrator to aid the identification of the unit, network or building.

Elapsed Time Indicator

The elapsed time indicator attribute presents the total time in days, hours, minutes and seconds since the last system restart. The system can restart for several reasons, for example, commanded reboot from the system reboot webpage, or a power cycle of the equipment.

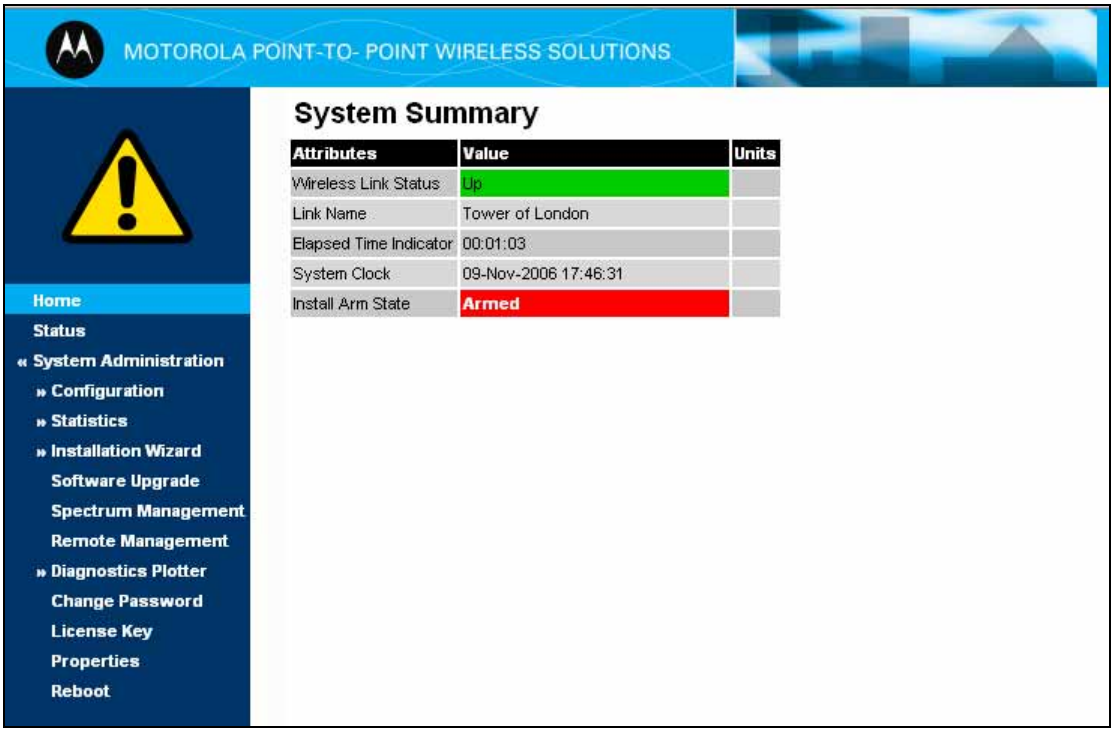
System Clock

If SNTP (Simple Network Time Protocol) is enabled, or the clock has been set, then a system clock attribute is displayed giving the date and time of the last page refresh. Section 7.10.8 “SNTP (Simple Network Time Protocol)” explains how to enable SNTP and Section 7.10.9 “Setting the clock” explains how to set the clock.

7.2.1 Home Page Alarm Display

The home page is also used to display all outstanding major system alarms. Whenever system alarms are asserted, a yellow warning triangle is displayed on web page navigation bar. The warning triangle will be visible from all web pages. Clicking the warning triangle will cause the web page to jump back to the system homepage. Figure 37 shows a sample alarm screen.

Figure 37 - Alarm Warning Triangle



7.2.2 System Alarms

The following system alarms are defined:

Ethernet Link Status

Current status of the Ethernet link. If there are any problems with the Ethernet interface, this alarm will be asserted. This alarm will most likely be seen if the unit has no Ethernet cable plugged into its Ethernet socket. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Telecoms Channel Status

Indicates an alarm condition on the telecoms channel. Alarm conditions are listed in Table 8.

Table 8 – Telecoms Channel Status Alarm Conditions

Alarm Condition	Meaning
No Signal (Local)	There is no telecoms signal present at the connection to the ODU at the local end.
No Signal (Remote)	There is an absence of telecoms data across the wireless link.
No Signal (Local and Remote)	The above two alarm conditions occur concurrently.
Remote Timing	There is insufficient wireless capacity available to carry telecoms data. Under these conditions telecoms timing information is still sent to keep the telecoms clocks synchronized.
No Signal (Local) and Remote Timing	Indicates both no local signal and remote timing.

In remote timing mode the ODU will transmit an Alarm Indication Signal (AIS), consisting of all-ones, from the telecoms interface. A change of state may generate an SNMP trap and/or SMTP email alert.

See section 7.7.3.1 “Telecoms Interface” for a description of the Telecoms Interface.

Telecoms Interface Loopback

The loopback status of the telecoms channel. This is intended for installation testing and should be set to 'None' for normal operation. The wire connections to a unit can be tested by applying a 'Copper' loopback to the local unit. The wireless connection to the remote unit can be tested by applying a 'Wireless' loopback to the remote unit with no loopback on the local unit.

A change of state may generate an SNMP trap and/or SMTP email alert. The loopback can be disabled from the telecoms configuration sub menu (see Section 7.5.5 “Telecoms Configuration”).

See section 7.7.3.1 “Telecoms Interface” for a description of the Telecoms Interface.

Region Code

The region code prohibits the wireless unit from operating outside the regulated limits. An invalid region code indicates a corrupted license key. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Install Status

A non-OK value indicates that signaling was received with the wrong MAC address. Note that it is very unusual to detect this, because units with wrongly configured Target MAC Address will normally fail to establish a wireless link. However, rare circumstances may establish a partial wireless link and detect this situation. A non-OK value on start-up, or a change of value during operation, may generate an SNMP trap and/or SMTP email alert.

Install Arm State

This alarm warns when a wireless unit is in installation mode. After installation the wireless unit should be disarmed. This will increase the wireless link's data-carrying capacity and stop the installation tone generator. The wireless link is disarmed from the 'Installation Wizard' see Section 7.7.6 "Disarm". A change of state may generate an SNMP trap and/or SMTP email alert.

Unit Out Of Calibration

The unit is out of calibration and must be returned to the factory using the RMA process for re-calibration.

Encryption Enable Mismatch

Encryption has been enabled on one end of the wireless link but not the other. For more information, see section 13 "AES Encryption".

Incompatible Region Codes

The PTP 500 Series Bridge uses region codes to comply with local regulatory requirements governing the transmission of wireless signals in the frequency bands in which it operates. Region codes can only be changed by obtaining a new PTP 500 Series license key. If this alarm is encountered, the appropriate license keys from the country of operation should be obtained from your distributor. Applying license keys containing the same region codes to both ends of the link will remove the alarm. A change of state may generate an SNMP trap and/or SMTP email alert.

No Wireless Channel Available

Spectrum Management was unable to locate a suitable wireless channel to operate on. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Wireless Link Disable Warning

This warning is displayed if the Wireless link has been administratively disabled via the SNMP Interface (see Section 7.10 "Remote Management"). The Wireless Interface MIB-II ifAdminStatus attribute has been set to DOWN. To enable the Ethernet interface, set the ifAdminStatus attribute to UP. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Ethernet Link Disable Warning

This warning is displayed if the Ethernet link has been administratively disabled via the SNMP Interface (see section 7.10 "Remote Management"). The Ethernet Interface MIB-II ifAdminStatus attribute has been set to DOWN. To enable the Ethernet interface, set the ifAdminStatus attribute to UP. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Ethernet Configuration Mismatch Alarm

The detection of Ethernet fragments (runt packets) when the link is in full duplex is an indication of an auto-negotiation or forced configuration mismatch. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Incompatible Master and Slave

A non-zero value indicates that the master and slave ends of the wireless link are different hardware products, or have different software versions. Note that it is very unusual to detect this because incompatible units will normally fail to establish a wireless link. However, some combinations may establish a partial wireless link and detect this situation. Note that a non-zero value may generate an SNMP trap and/or SMTP email alert.

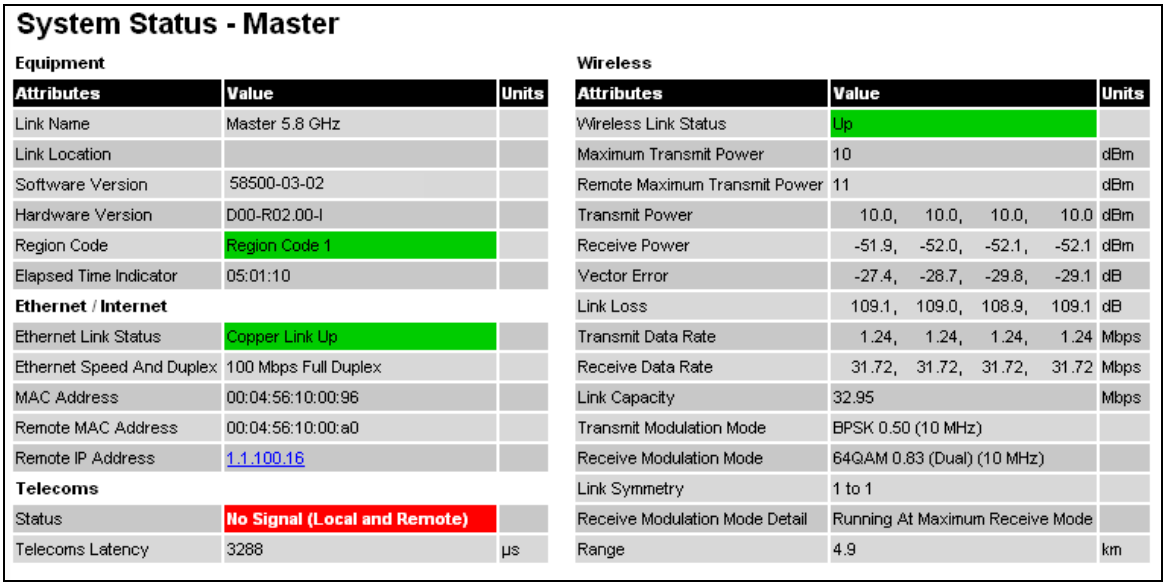
SNTP Synchronization failed

This warning indicates that SNTP has been enabled but that the unit is unable to synchronize with the specified SNTP server. Section 7.10.8 “SNTP (Simple Network Time Protocol)” explains how to configure SNTP. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

7.3 System Status

The status page (Figure 38) gives the system administrator a detailed view of the operation of the PTP 500 Series Bridge from both the wireless and network perspectives.

Figure 38 - Status Page



System Status - Master

Equipment

Attributes	Value	Units
Link Name	Master 5.8 GHz	
Link Location		
Software Version	58500-03-02	
Hardware Version	D00-R02.00-I	
Region Code	Region Code 1	
Elapsed Time Indicator	05:01:10	
Ethernet / Internet		
Ethernet Link Status	Copper Link Up	
Ethernet Speed And Duplex	100 Mbps Full Duplex	
MAC Address	00:04:56:10:00:96	
Remote MAC Address	00:04:56:10:00:a0	
Remote IP Address	1.1.100.16	
Telecoms		
Status	No Signal (Local and Remote)	
Telecoms Latency	3288	µs

Wireless

Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	10	dBm
Remote Maximum Transmit Power	11	dBm
Transmit Power	10.0, 10.0, 10.0, 10.0	dBm
Receive Power	-51.9, -52.0, -52.1, -52.1	dBm
Vector Error	-27.4, -28.7, -29.8, -29.1	dB
Link Loss	109.1, 109.0, 108.9, 109.1	dB
Transmit Data Rate	1.24, 1.24, 1.24, 1.24	Mbps
Receive Data Rate	31.72, 31.72, 31.72, 31.72	Mbps
Link Capacity	32.95	Mbps
Transmit Modulation Mode	BPSK 0.50 (10 MHz)	
Receive Modulation Mode	64QAM 0.83 (Dual) (10 MHz)	
Link Symmetry	1 to 1	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Range	4.9	km

The page is subdivided into four categories:

- **Equipment**: This contains the unit's inventory and identification information.
- **Wireless**: This presents the key wireless metrics, which are displayed as a series of measurements.
- **Ethernet/Internet**: This describes the unit's network identity and connectivity.
- **Telecoms**: This describes the unit's E1/T1 telecoms interface parameters.

The status page can be configured to refresh itself at an operator defined rate (if the user is logged in as system administrator). The refresh period defaults to 3600 seconds and can easily be changed to refresh at any period between 2 seconds and 3600 seconds. Pressing the 'Update Page Refresh Period' button causes a new page refresh period to be adopted by the system. The page refresh mechanism uses a HTML Meta refresh command. Therefore the refresh is always initiated by the local browser and not by the PTP 500 Series Bridge at this interval.

The two PTP 500 Series bridges units are arranged in a master and slave relationship. The roles of the units in this relationship are displayed in the page title. The master unit will always have the title '- Master', and the slave will always have '- Slave' appended to the 'Systems Status' page title.

The following attributes are displayed on the status page:

Link Name

The link name is allocated by the system administrator and is used to identify the equipment on the network. The link name attribute is limited to a maximum size of 63 ASCII characters.

Link Location

The link location is allocated by the system administrator and can be used as a generic scratch pad to describe the location of the equipment or any other equipment related notes. The link location attribute is limited to a maximum size of 63 ASCII characters.

Software Version

The attribute describes the version of software installed on the equipment. The format of the attributes is *FFSSS*-XX-*YY* where *FF* is the frequency variant (5.4 or 5.8 GHz), *SSS* is the System Release, *XX* is the major release version and *YY* is the minor release version.

Hardware Version

The hardware version attribute contains all the combined hardware version information. The attribute is formatted as DXX-RAA.BB-Z where DXX contain the version of the digital card, AA is the major hardware version number, BB is the minor hardware version number and Z describes the antenna type which can be I (integrated) or C (connectorized).

Region Code

The region code is used by the system to constrain the wireless to operate within regulatory regime of the particular country. The region code is encoded in the product license key. If the operator wishes to change region code, a new license key must be obtained from Motorola or the local point-to-point distributor / system integrator.

Elapsed Time Indicator

The elapsed time indicator attribute presents the total time in years, days, hours, minutes and seconds since the last system restart. The system can restart for several reasons, for example commanded reboot from the system reboot web page, or a power cycle of the equipment.

Ethernet Link Status:

Current status of the Ethernet link. A state of 'Up' with a green background indicates that an Ethernet link is established. A state of 'Down' with a red background indicates that the Ethernet link is not established.

Ethernet Speed and Duplex

The negotiated speed and duplex setting of the Ethernet interface. The speed setting is specified in Mbps.

Full Duplex data transmission means that data can be transmitted in both directions on a signal carrier at the same time. For example, on a local area network with a technology that has full duplex transmission; one workstation can be sending data on the line while another workstation is receiving data.

Half Duplex data transmission means that data can be transmitted in both directions on a signal carrier, but not at the same time. For example, on a local area network using a technology that has half duplex transmission, one workstation can send data on the line and then immediately receive data on the line from the same direction in which data was just transmitted.

MAC Address

MAC address of the unit.

Remote MAC Address

MAC address of the remote unit.

Remote IP Address

Hyperlink to the other side of the Link. The IP address of the peer link is displayed if the Link is UP, otherwise “unavailable” is displayed.

Telecoms Status

Indicates the current status of the telecoms channel. Channels which are disabled during installation are marked as such. Correctly operating channels display "Up" on a green background, but alarm conditions (described in Section 7.2.1 “Home Page Alarm Display”) have a red background.

Telecoms Latency

If E1 or T1 is enabled, this shows the end-to-end latency of the telecoms link.

Automatic Page Refresh Period in Seconds

Only displayed when the user is logged on as system administrator. Enter the required refresh period.

Wireless Link Status

As the attribute name suggests it displays the current status of the wireless link. A state of ‘Up’ on a green background indicates that a point-to-point link is established. A state of ‘Down’ on a red background indicates that the wireless link is not established.

Maximum Transmit Power

The maximum transmit power that the local wireless unit is permitted to use to sustain a link.

Remote Maximum Transmit Power

The maximum transmit power that the remote wireless unit is permitted to use to sustain a link.

Transmit Power

Transmit power histogram is expressed in dBm and presented as: max, mean, min, and latest. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. The Transmit Power may be less than the maximum permitted Transmit Power due to the TPC (Transmit Power Control) mechanism. This mechanism adjusts Transmit Power to achieve best link performance while minimizing the interference it causes to other users of this part of the Spectrum. See Section 7.3.1 “Histogram Data”.

Receive Power

Receive power histogram is expressed in dBm and presented as: max, mean, min, and latest. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 7.3.1 “Histogram Data”.

Vector Error

The vector error measurement compares the received signal's In phase / Quadrature (IQ) modulation characteristics to an ideal signal to determine the composite error vector magnitude. The results are stored in an histogram and expressed in dB and presented as: max, mean, min and latest. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. The expected range for Vector Error would be approximately -1.5 dB (NLOS link operating at sensitivity limit on BPSK 0.50) to –28 dB (short LOS link running 64 QAM 0.83). See Section 7.3.1 "Histogram Data".

Link Loss

The link loss is the total attenuation of the wireless signal between the two point-to-point units. See Section 7.3.1 "Histogram Data".

The link loss calculation presented below:

Equation 3 - Link Loss

$$P_{ll} = P_{T_x} - P_{R_x} + g_{T_x} + g_{R_x}$$

Where	is
P_{ll}	Link Loss (dB)
P_{T_x}	Transmit power of the remote wireless unit (dBm)
P_{R_x}	Received signal power at the local unit (dBm)
g_{T_x}, g_{R_x}	Antenna gain at the remote and local units respectively (dBi). The antenna gain of the PTP 500 Series bridge (23.5 dBi) is used unless one or both of the units is a Connectorized version.

Transmit Data Rate

The data rate in the transmit direction, expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 7.3.1 "Histogram Data". Expected data rates can be found in Section 12 "Data Rate Calculations".

Receive Data Rate

The data rate in the receive direction, expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 7.3.1 "Histogram Data". Expected data rates can be found in Section 12 "Data Rate Calculations".

Link Capacity

The maximum aggregate data rate capacity available for user traffic, assuming the units have been connected using Gigabit Ethernet. The link capacity is variable and depends of the prevailing wireless conditions as well as the distance (range) between the two wireless units..

Transmit Modulation Mode

The modulation mode currently being used on the transmit channel. A list of all the modulation modes can be found in Section 12 "Data Rate Calculations", where data rate calculations plots are given for each available modulation mode.

Receive Modulation Mode

The modulation mode currently being used on the receive channel. A list of all the modulation modes can be found in Section 12 “Data Rate Calculations”, where data rate calculations plots are given for each available modulation mode.

Link Symmetry

A ratio that expresses the division between transmit and receive time in the TDD frame. The first number in the ratio represents the time allowed for the transmit direction and the second number represents the time allowed for the receive direction.

NOTE

Link Symmetry is configured at the master ODU only. The appropriate matching Link Symmetry is set at the slave ODU automatically. For example, if Link Symmetry is configured as “3 to 1” at the master ODU, then the slave ODU will be set automatically as “1 to 3”. In this example, the master-slave direction has double the capacity of the slave-master direction.

Receive Modulation Mode Detail

This supplies the user with information regarding the receive modulation mode in use. Possible values are:

“Running at maximum receive mode”

“Running at user-configured Max Modulation Mode”

“Restricted due to byte errors on the wireless link or local Ethernet Tx Fifo Drops”

“Restricted because a DFS channel change is in progress”

“Restricted due to telecoms acquisition mode”

“Restricted due to the low Ethernet link speed”

“Limited by the wireless conditions”

Range

The range between the PTP 500 Series bridge ODUs. The range is automatically set during installation. Range is displayed in km by default, but if the user would prefer to display range using Miles, the ‘Distance Units’ attribute should be set to imperial, as described in Section 7.14 “Properties”.

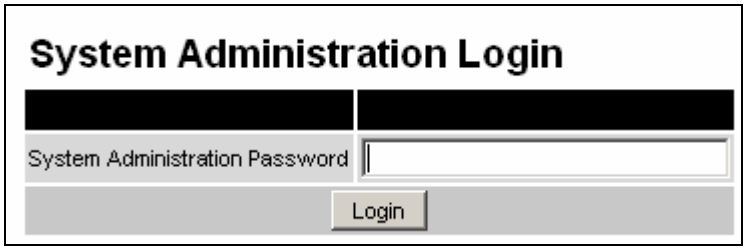
7.3.1 Histogram Data

The histogram is calculated over a one hour period. If the equipment has been running for less than one hour, then the histogram is calculated over the current elapsed time. The data used to compute the histogram statistics can be downloaded in an ASCII comma separated value (CSV) format via the diagnostics CSV Download page, see Section 7.11.2 “CSV Download”.

7.4 System Administration

Figure 39 shows the system administration login page. By default a system administrator password is not set. Click the **Login** button to access the system administration features.

Figure 39 - System Administration Login Page



Once the password has been set using the 'Change Password' menu item, the system administration pages will only be available after the user has entered the correct password.

The menu options that are available to the system administrator are:

- Configuration
- Statistics
- Installation Wizard
- Software Upgrade
- Spectrum Management
- Remote management
- Diagnostics Plotter
- Change Password
- License Key
- Properties
- Reboot

7.5 Configuration

The configuration of the PTP 500 Series Bridge is organized into the following sections:

- System Configuration
- LAN Configuration
- QoS Configuration
- Telecoms Configuration
- Save and Restore

The general configuration allows modification of high level administrative (descriptive) attributes and high level wireless configuration.

The LAN configuration sub menu allows the system administrator to modify the Ethernet and IP configuration of the PTP 500 Series Bridge.

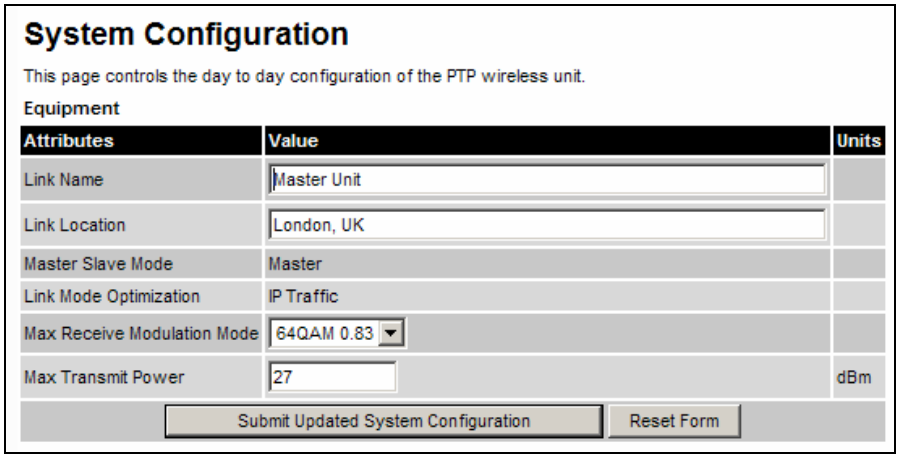
The telecoms submenu displays the current status of the telecoms interface and allows the configuration of interface loopbacks.

The save and restore submenu allows the system administrator to backup and restore the bridge configuration. It is recommended after a unit has been successfully installed; a copy of the active configuration is taken and archived by the system administrator.

7.5.1 System Configuration

The system configuration page (Figure 40) is used by the system administrator to configure the PTP 500 Series Bridge's high level administrative (descriptive) attributes and high level wireless configuration.

Figure 40 - System Configuration Page



While the majority of the system configuration is entered during installation and should never require changing, this page offers the system administrator the ability to change the basic system parameters for both the wireless and Ethernet components.

Link Name

User defined identity for the unit (max 63 characters).

Link Location

Can be used as a generic scratch pad to describe the location of the equipment.

Master Slave Mode and Link Mode Optimization

Current settings are displayed and can be modified using the Installation Wizard pages 7.7 “Installation Wizard”.

Max Receive Modulation Mode

This is the maximum mode the unit will use as its adaptive modulation. By default the Max Receive Modulation Mode is the highest mode available.

For minimum error rates, set the maximum modulation mode to the minimum necessary to carry the required traffic.

Maximum Transmit Power

This specifies the maximum transmit power in dBm of the system. It is country dependent and although the user can change this in 1dB steps, it will be limited to that country’s regulations.

NOTE

UK requirement: In the UK there is a legal requirement to provide a minimum of 19 dB of transmit power control range. When the equipment is operating with a UK License Key, an additional facility is provided on the configuration page that allows the transmitted power to be reduced by 19 dB compared to the maximum allowed with a simple single step control.

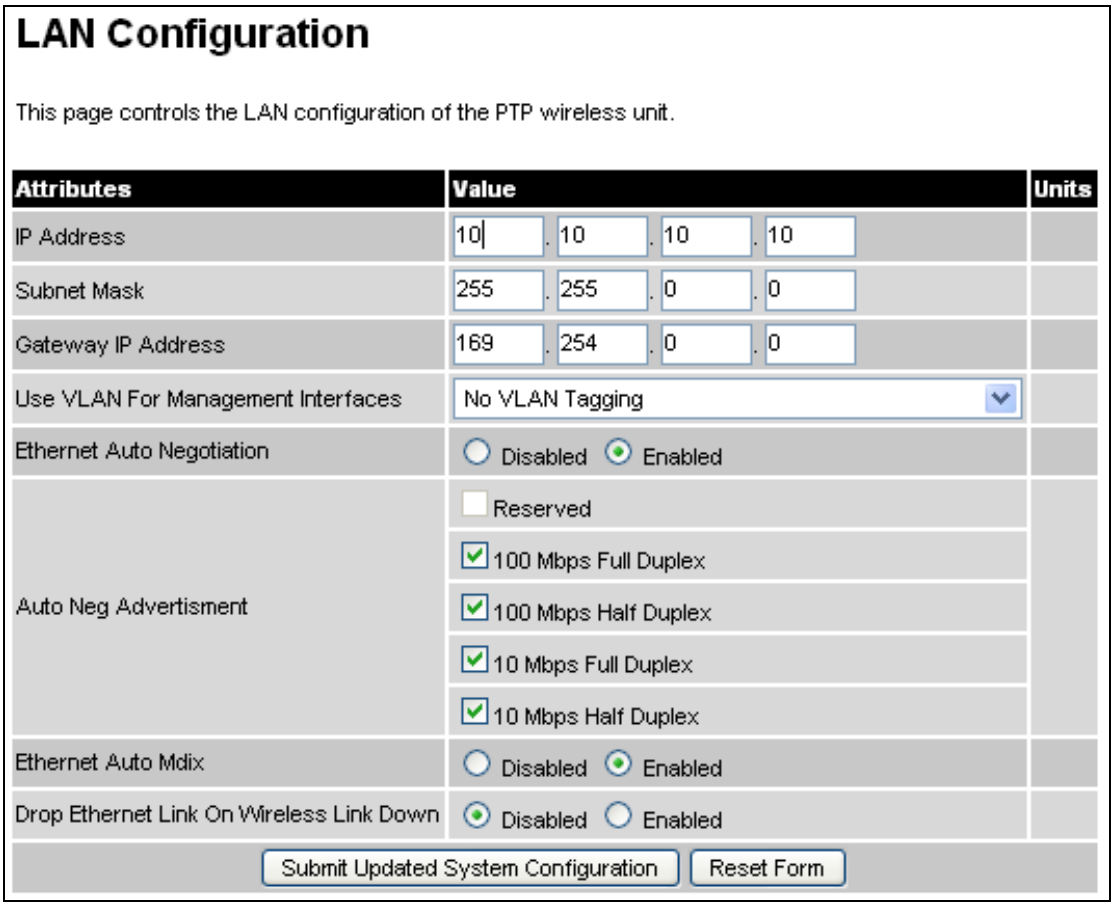
NOTE

Why Reduce Transmit Power? If the link losses are low and the link data rate and availability targets are being easily achieved, the transmitted power level may be reduced with a consequent benefit to other users of the band, such as fixed satellite links.

7.5.2 LAN Configuration

The LAN configuration page (Figure 41) is used by the system administrator to configure the PTP 500 Series Bridge's LAN interface.

Figure 41 - LAN Configuration Page



All of the LAN Configuration attributes are non-volatile, so once set, they will be used by the unit even after a power on reboot. The LAN Configuration page contains the following fields:

IP Address

Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.

Subnet Mask

A subnet allows the flow of network traffic between hosts to be segregated based on a network configuration.

Gateway IP Address

The IP address of a computer / router on the current network that acts as a gateway.

Use VLAN For Management Interfaces

This controls use of VLAN tags at the management interfaces (WWW/SNMP/SMTP/SNTP). See Section 7.5.2.2 “LAN Configuration Page for VLAN”.

Ethernet Auto Negotiation

This enables the Ethernet configuration to be forced rather than auto negotiated.

⚠ CAUTION

The IEEE802.3 specification recommends enabling Auto Negotiation. The configuration should only be forced if you are having problems with auto negotiation. You must ensure that you configure both this unit and the Ethernet port to which it is connected identically. If you force a fixed Ethernet Configuration on the PTP 500 Series bridge then you MUST also force the same fixed configuration on the equipment to which it is connected. If you fail to force the configuration of the connected equipment, its automatic configuration mechanisms will normally cause a duplex mismatch, and you will receive greatly reduced throughput!

When Ethernet Auto Negotiation is Disabled the format of the LAN configuration page changes see Section 7.5.2.3 “LAN Configuration Page – Manual Ethernet Configuration”.

Auto Neg Advertisement

This controls the rates that the auto negotiation mechanism will advertise as available.

⚠ CAUTION

Over the air throughput will be capped to the rate of the Ethernet interface at the receiving end of the link.

Ethernet Auto Mdix

This enables/disables the Auto Medium Dependent Interface (MDI)/Medium Dependent Interface Crossover (MDIX) capability. Default is “Enabled”.

Drop Ethernet Link On Wireless Link Down

When this option is enabled the Ethernet link is momentarily dropped when the wireless link goes down. This feature is used to indicate to the connected network equipment that this Ethernet link is no longer available, thus causing STP (Spanning Tree Protocol) to re-route packets through an alternative link.

7.5.2.1 Reboot Verification

A number of attributes, such as IP Address, Subnet Mask and Gateway IP Address and VLAN settings will require a reboot before they are used. If any of these attributes are changed a reboot screen appears asking the user to verify the reboot (Figure 42 or Figure 43).

Figure 42 - Configuration Reboot Page

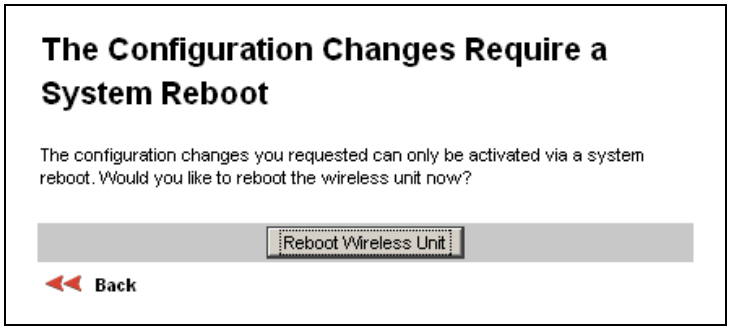
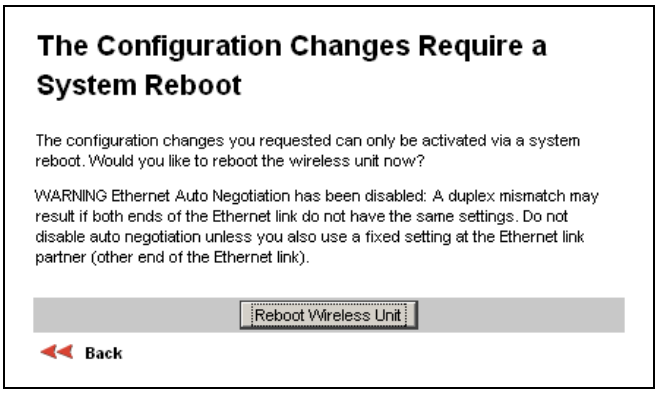


Figure 43 - Configuration Reboot Page - Ethernet Auto Negotiation Disabled



This will be followed by a pop-up dialogue box asking to confirm the action.

NOTE

At this point you will lose connection to the unit. If you have just changed the IP Address, you now have to reconnect to the unit using the address just set.

7.5.2.2 LAN Configuration Page for VLAN

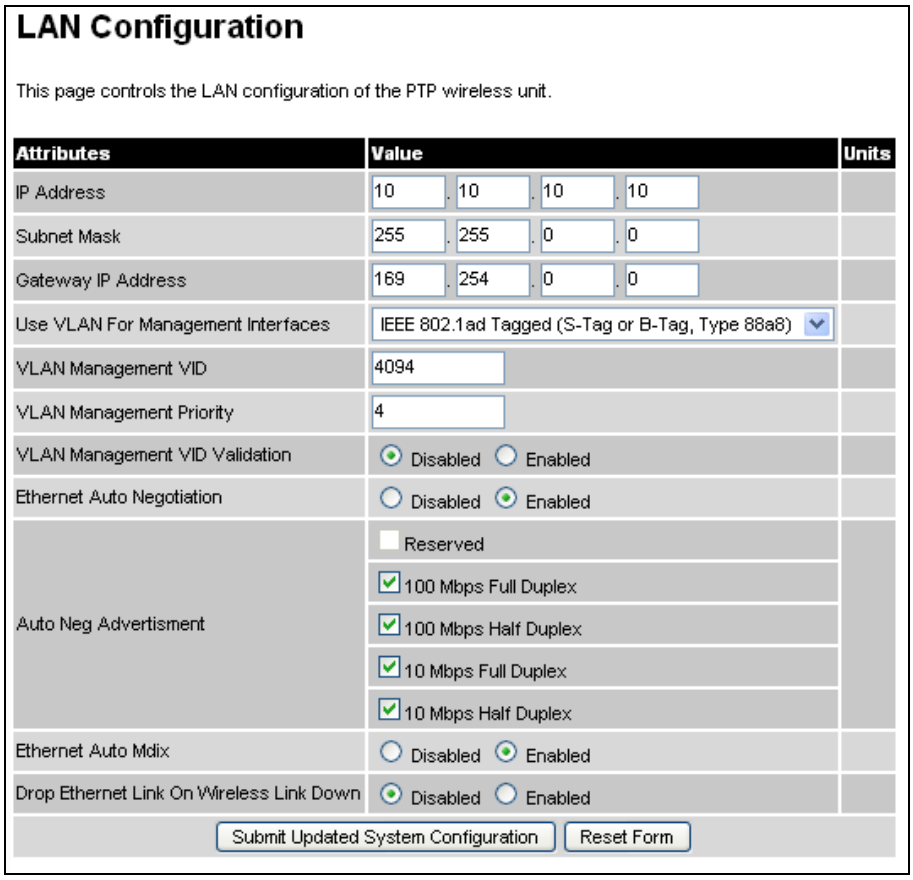
The layout of the LAN Configuration page changes if this attribute is enabled in order to allow the VLAN VID and VLAN Priority to be set, see Figure 44. The VLAN settings are applied only after the unit is rebooted.

CAUTION

You must ensure that you can access the VLAN which you configure here, otherwise you will be unable to access the unit following the next reboot.

The PTP 500 management function is only compatible with single VLAN tagged packets. Any management packet with two or more packets will be ignored.

Figure 44 - VLAN Configuration Fields



When VLAN is enabled, the LAN Configuration page contains the following extra fields:

Use VLAN For Management Interfaces

This control can be configured with one of the following three values:

No VLAN Tagging

IEEE 802.1Q Tagged (C-Tag, Type 8100)

IEEE 802.1ad Tagged (S-Tag or B-Tag, Type 88a8)

VLAN Management VID

This 802.1Q or 802.1ad VLAN ID (VID) will be included in packets generated by the management interfaces. Valid settings are in the range 0 to 4094.

VLAN Management Priority

This 802.1Q or 802.1ad VLAN Priority will be included in packets generated by the management interfaces. Valid settings are in the range 0 to 7.

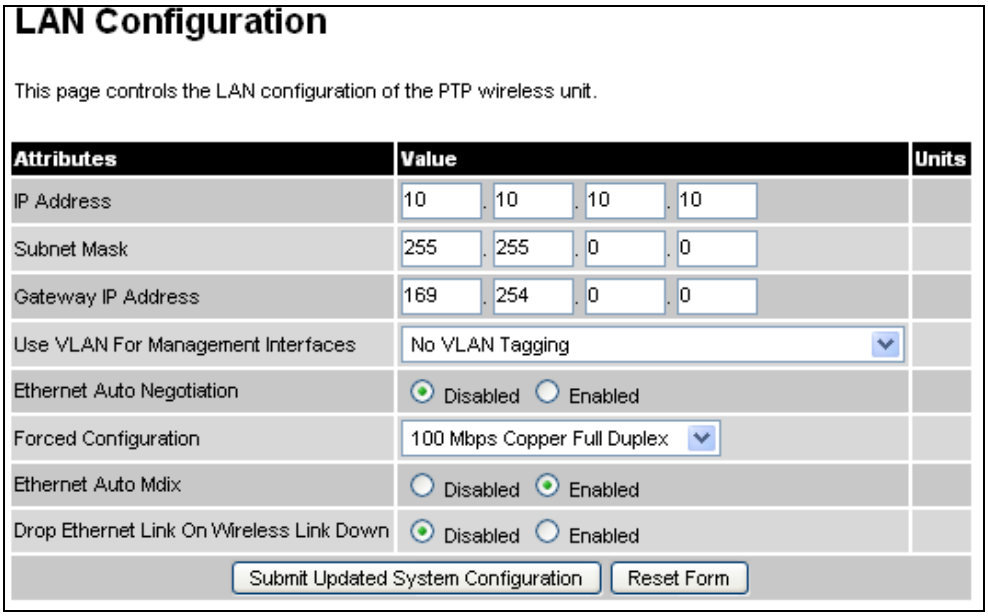
VLAN Management VID Validation

If enabled, the management interfaces will only respond to Ethernet packets tagged with the configured Management VID; otherwise packets with any VID will be accepted.

7.5.2.3 LAN Configuration Page for Manual Ethernet Configuration

The layout of the LAN Configuration page changes if Ethernet Auto Negotiation is Disabled, see Figure 45.

Figure 45 - LAN Configuration Page - Manual Ethernet Configuration



When Ethernet Auto Negotiation is Disabled, the LAN Configuration page contains the following extra field:

Force Configuration

This option allows the user to force the speed and duplex setting of the Ethernet interface. Over the air throughput will be capped to the rate of the Ethernet interface at the receiving end of the link.

NOTE

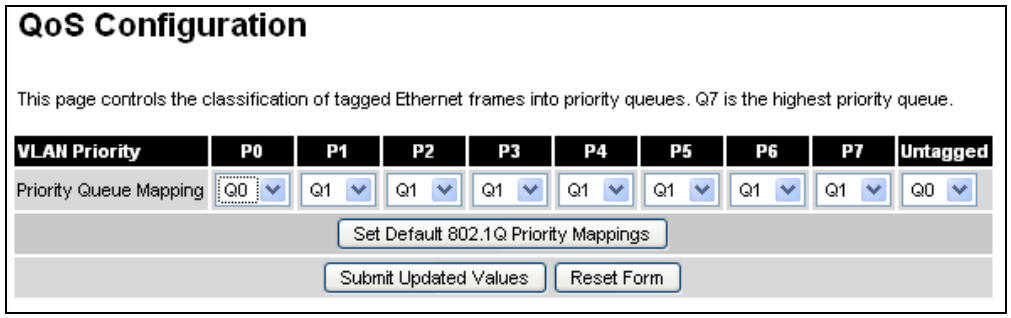
Instead of forcing configuration, the IEEE802.3 specification recommends enabling Auto Negotiation with only the specific ability or abilities advertised.

.

7.5.3 QoS Configuration Page

The QoS configuration page (Figure 46) allows the system administrator to configure the classification of priority encoded Ethernet frames into up to eight traffic classes.

Figure 46 - QoS Configuration Page



Priority Queue Mapping

Specifies the VLAN priority flag to packet queue mapping. The higher the queue number the greater its priority.

7.5.3.1 Quality of Service Default Settings

The default classification rules are as shown in Table 9.

Table 9 – QoS Default Settings

Link Layer Priority	Traffic Class
Untagged	Q0
0	Q0
1	Q1
2	Q1
3	Q1
4	Q1
5	Q1
6	Q1
7	Q1

In the case where the ODU is upgraded from an earlier release that does not support the 'Multiple Traffic Classes' feature, the classification rules will be initialized as defined in Table 9 modified to reflect the stored value of "VLAN High Priority Traffic Threshold". For example, if the existing threshold was set to "VLAN User Priority 4 and Above" then the classification rules would be initialized as shown in Table 10.

Table 10 – Classification rules upgrade example

Link Layer Priority	Traffic Class
Untagged	Q0
0	Q0
1	Q0
2	Q0
3	Q0
4	Q1
5	Q1
6	Q1
7	Q1

The user interface allows also to configure IEEE802.1Q classification rules as shown in Table 11 using the button ‘Set Default 802.1Q Priority Mappings’.

Table 11 – IEEE802.1Q Classification rules

Link Layer Priority	Traffic Class
Untagged	Q1
0	Q1
1	Q0
2	Q2
3	Q3
4	Q4
5	Q5
6	Q6
7	Q7

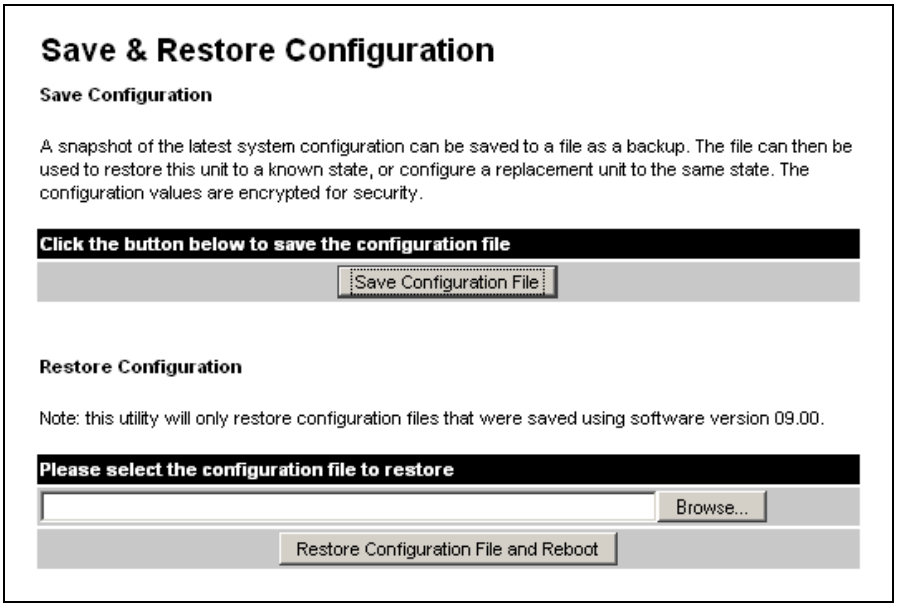
7.5.4 Save and Restore

The save and restore feature of a PTP 500 Series Bridge allows the system administrator to backup the operation configuration of the wireless unit. It is recommended that this facility is used immediately after a successful PTP 500 Series Bridge installation or prior to any software upgrade. In the unlikely event that a unit has to be replaced in the field, the replacement unit can be reconfigured by simply playing back the saved configuration file.

7.5.4.1 Save Configuration File

To save the configuration file click on the 'Save Configuration File' button (Figure 47) and save the configuration file (.cfg) to the hard drive of your computer.

Figure 47 - Save and Restore Configuration Page

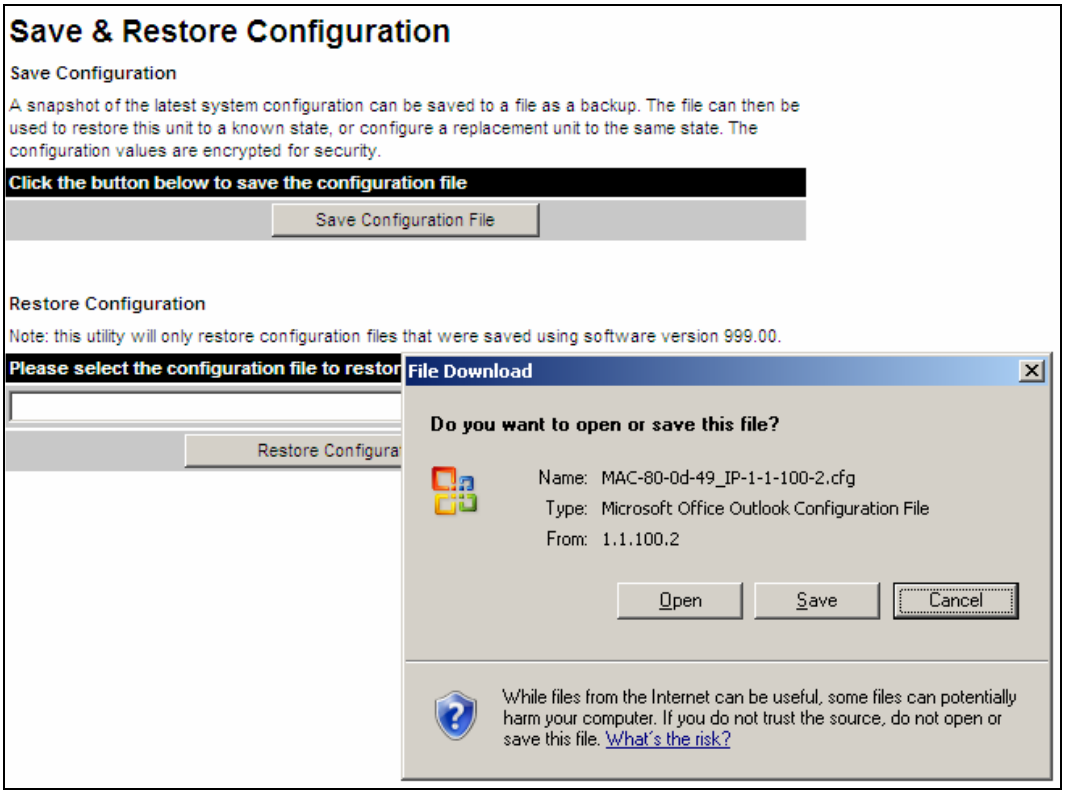


The configuration file format is **MAC-mm-mm-mm_IP-iii-iii-iii-iii.cfg**, where **mm** and **iii** are the lower 3 bytes of the MAC address and the unit IP address respectively.

NOTE

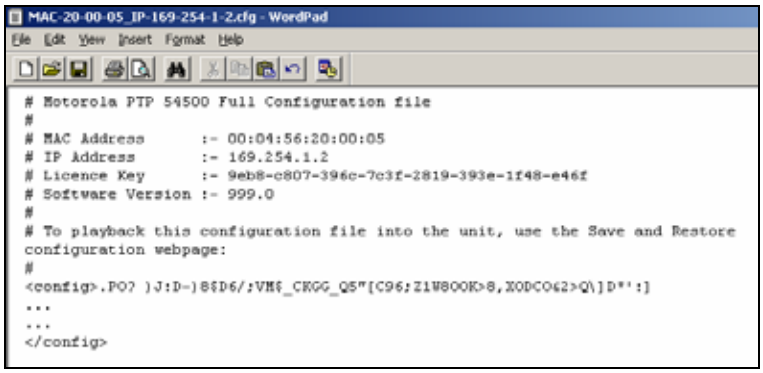
There is a feature of Internet Explorer (all versions) that looks at the content of any downloadable file and decides whether to treat the file as ASCII or binary. As a result of this feature, Internet Explorer always treats the configuration file as ASCII and attempts to display it instead of downloading it. Firefox (all versions) makes no such assumption.

Figure 48 - Save Configuration File Screen



The configuration file is encoded using an ASCII encoding scheme. An example is show in Figure 49.

Figure 49 – PTP 500 Example Configuration File



⚠ CAUTION

The configuration file is currently restricted to a single software version and can only be restored into a wireless unit operating the software version indicated in the configuration file header.

7.5.4.2 Restore Configuration File

The configuration file can also be used when swapping out a faulty wireless unit. If one of the wireless units is replaced on a wireless link a configuration file captured from the faulty unit can be uploaded into the new unit to speed up replacement.

NOTE

The license key of the faulty unit should be setup on the replacement unit before the configuration file is loaded. This can be obtained either from the Deployment Guide supplied with the faulty wireless unit or directly from Motorola. The target MAC address at the other end needs to be changed to ensure that it is using the MAC address of the replaced unit.

The restoration of configuration files can be performed using the Restore configuration tool. Using the browser button to locate the configuration file you wish to restore then click the 'Restore Configuration File and Reboot' button (Figure 50). The user will then be prompted to confirm the action (Figure 51).

Figure 50 - Restore Configuration File Pop Up Screen

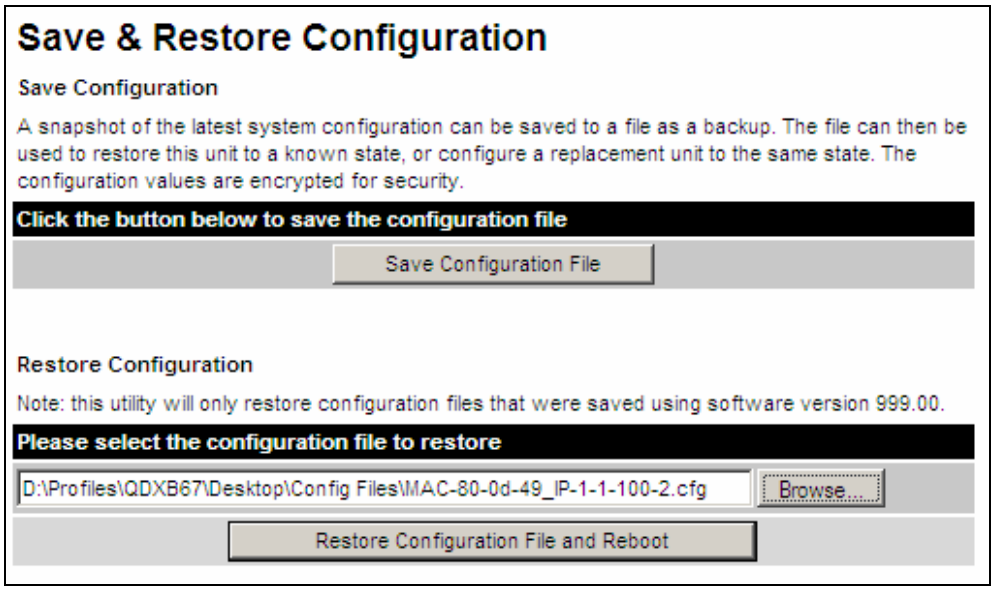
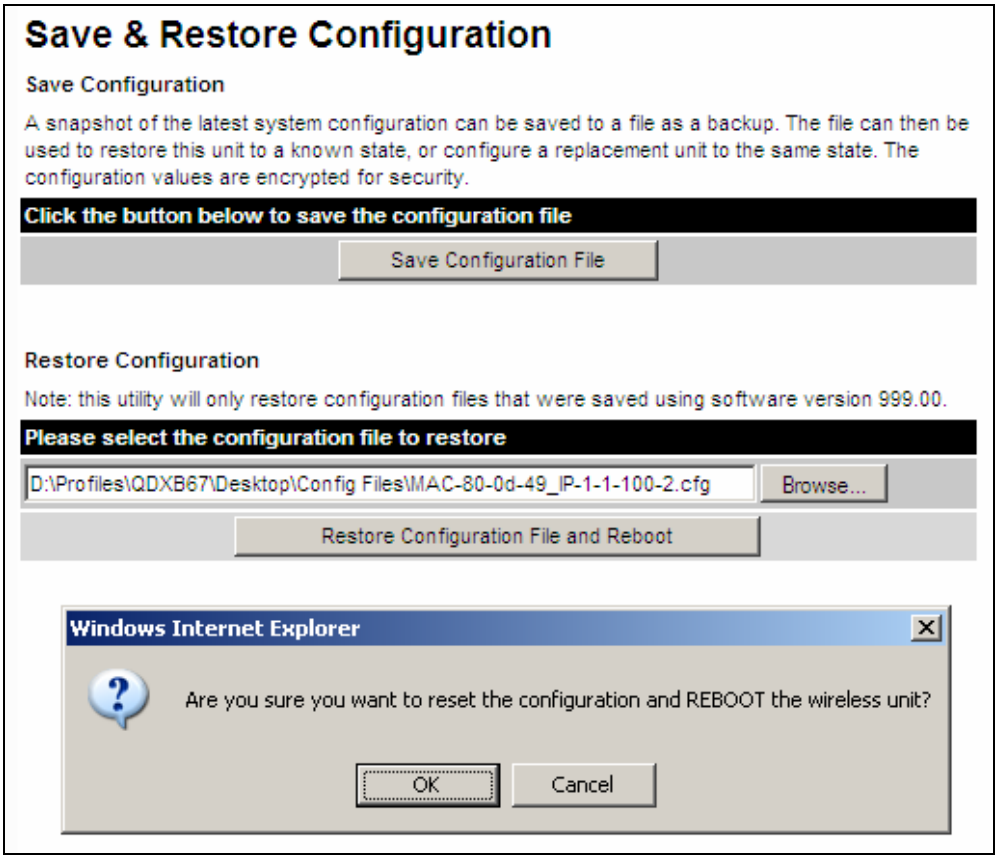


Figure 51 - Reset Configuration and Reboot Confirmation Pop-up



On confirmation the PTP 500 Series Bridge will:

- Upload the configuration file
- Perform data integrity checking
- Erase previous configuration
- Apply the new configuration
- Restart

After the unit has restarted the entire configuration from the configuration file will now be active. The IP address of the unit may have also been changed. The user can check the new IP address by reading the header of the configuration file, Figure 49.

⚠ CAUTION

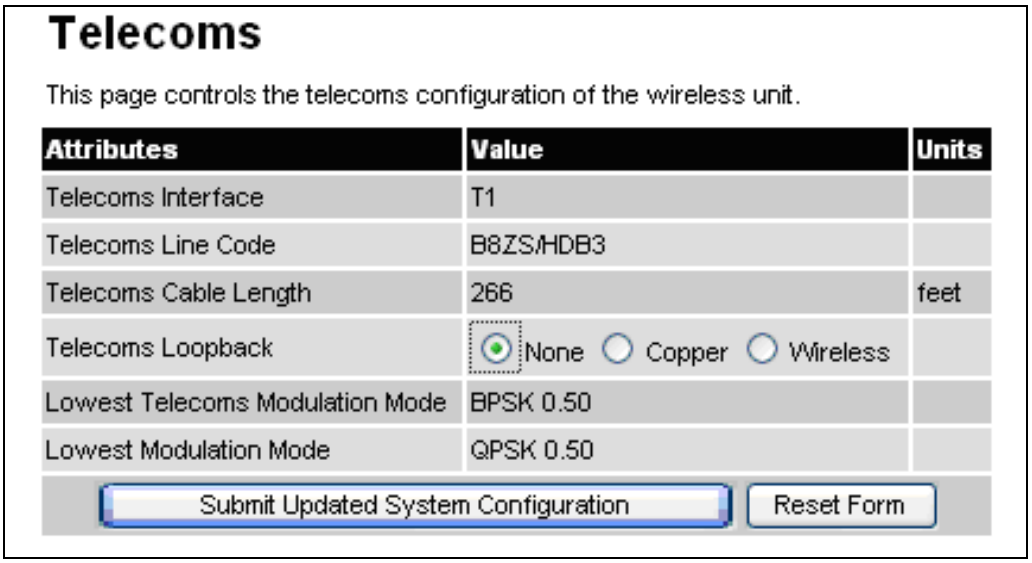
A reboot is always required to restore a configuration file.

7.5.5 Telecoms Configuration

The Telecoms page (Figure 52) is available when the Telecoms Interface has been set to either T1 or E1 in the Installation Wizard.

The unit displays the interface setting and line code for the available telecoms channel.

Figure 52 - Telecoms Data Entry



The Telecoms page contains the following fields:

Telecoms Interface

May be either T1 or E1, reflecting the Installation Wizard setting.

Telecoms Line Code

Displays the Line Code setting for the E1 or T1 channel. This must match the configuration of the connected equipment and may be set using the Installation Wizard.

Telecoms Cable Length

The Cable Length setting is applicable in T1 mode only and shows the cable length specified in the installation wizard.

Telecoms Loopback

Allows the T1 or E1 data stream to be looped back at the copper or wireless interface. During normal operation the loopback must be set to "None". It may be helpful during installation to test the telecoms links by performing loopback connections.

A "Copper" loopback connects the received data on a given telecoms interface to the transmit interface. A "Copper" loopback may be used, in conjunction with a Bit Error Rate Tester, to confirm that the correct connections have been made to the ODU. This mode cannot be used for resistance tests as it is only capable of looping back valid telecoms signals.

A "Wireless" loopback sends the telecoms data received across the wireless link back across the link on the same Telecom channel. The link may be checked using, for example, a Bit Error Rate Tester to ensure that no errors are detected.

A typical T1 or E1 installation might include a "Copper" loopback on the local unit followed by a "Wireless" loopback on the remote unit.

It is important to remove all loopbacks on channels for normal operation. Alarms on the Home Page indicate the presence of loopbacks on either channel.

Lowest Telecoms Modulation Mode

The user defined lowest modulation mode at which telecoms data can be sent. If the link cannot sustain telecoms data in this mode then the effective lowest modulation mode may differ

Lowest Modulation Mode

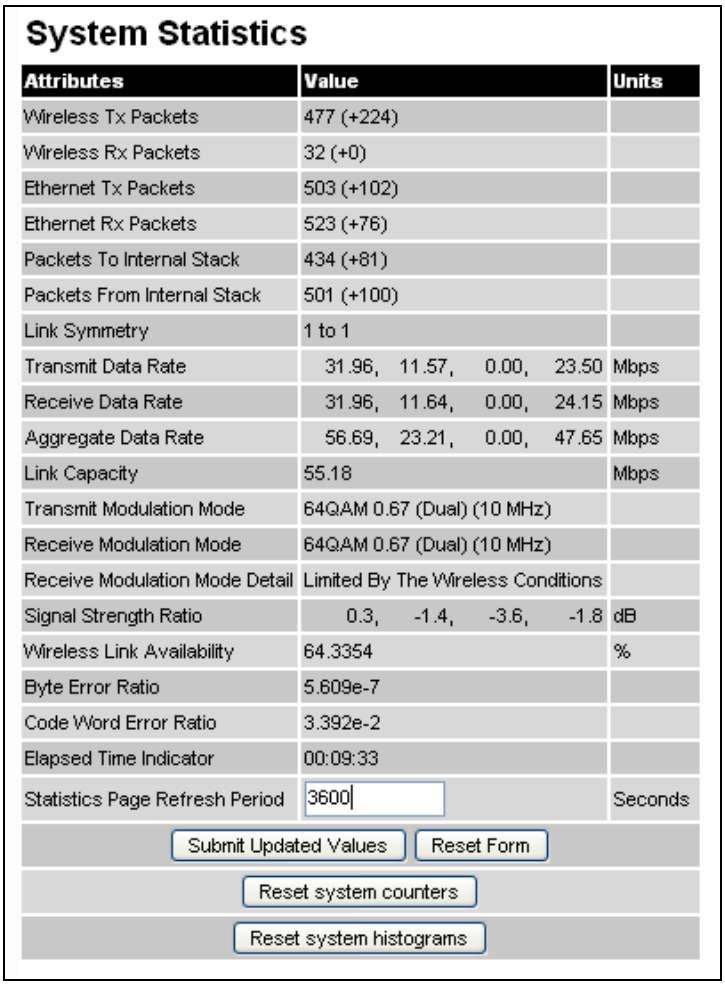
The modulation mode at which telecoms data will be sent.

7.6 Statistics

The System Statistics page (Figure 53) displays some key statistics of the Ethernet Bridge and the underlying wireless performance.

The numbers in brackets display the number of packets received since the last page refresh.

Figure 53 - System Statistics Page



The System Statistics page contains the following fields:

Wireless Tx Packets

This displays the total number of good packets the bridge has sent for transmission by the wireless interface.

Wireless Rx Packets

This displays the total number of good packets the bridge has received from the wireless interface.

Ethernet Tx Packets

This displays the total number of good packets the bridge has sent for transmission by the local Ethernet interface.

Ethernet Rx Packets

This displays the total number of good packets the bridge has received from the local Ethernet interface.

Packets To Internal Stack

This displays the total number of good packets the bridge has transmitted to the internal stack (for example, ARP requests, PING requests, HTTP requests).

Packets From Internal Stack

This displays the total number of good packets the bridge has received from the internal stack (for example ARP responses, PING replies, HTTP responses).

Link Symmetry

Link Symmetry: A ratio that expresses the division between transmit and receive time in the TDD frame. The first number in the ratio represents the time allowed for the transmit direction and the second number represents the time allowed for the receive direction.

Transmit Data Rate

The data rate in the transmit direction, expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 7.3.1 “Histogram Data”. Expected data rates can be found in Section 12 “Data Rate Calculations”.

Receive Data Rate

The data rate in the receive direction, expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 7.3.1 “Histogram Data”. Expected data rates can be found in Section 12 “Data Rate Calculations”.

Aggregate Data Rate

The sum of the data rate in the directions expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 7.3.1 “Histogram Data”. Expected data rates can be found in Section 12 “Data Rate Calculations”.

Link Capacity

The maximum aggregate data capacity available for user traffic under the current radio link conditions, assuming the units have been connected using Gigabit Ethernet. The sum of the displayed Transmit and Receive data rates may be lower than this figure if the link isn't fully loaded by the current traffic profile.

Transmit Modulation Mode

The modulation mode currently being used on the transmit channel. The number in brackets after the modulation mode and coding rate string is the effective data rate available to all MAC layer protocols. List of all the modulation modes can be found in Section 12 “Data Rate Calculations” ,where data rate calculations plots are given for each available modulation mode.

Receive Modulation Mode

The modulation mode currently being used on the receive channel. The number in brackets after the modulation mode and coding rate string is the effective data rate available to all MAC layer protocols. List of all the modulation modes can be found in Section 12 “Data Rate Calculations”, where data rate calculations plots are given for each available modulation mode.

Receive Modulation Mode Detail

This supplies the user with information regarding the receive modulation mode in use. Possible values are:

“Running at maximum receive mode”

“Running at user-configured Target Modulation Mode”

“Restricted because Installation is armed”

“Restricted because of byte errors on the wireless link”

“Restricted because a DFS channel change is in progress”

“Restricted due to the low Ethernet link speed”

“Limited by the radio conditions”

Signal Strength Ratio

The Signal Strength Ratio is the ratio of the power received by the Vertical / Horizontal receivers and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 7.3.1 “Histogram Data”.

Wireless Link Availability

Expresses the link availability as a percentage of time since the first successful registration after a system restart, expressed as a percentage to four decimal places.

Byte Error Ratio

The ratio of detected Byte errors to the total number of bytes since the last system reboot. This is a true measure of link quality as this measurement is made continually using null frames when there is no user data to transport.

Code Word Error Ratio

The ratio of uncorrected Codeword errors to the total number of Codewords, calculated since the last reset of the system counters.

Statistics Page Refresh Period

The statistics page refreshes automatically according to the setting entered here (in seconds).

Reset System Counters

By pressing this button all counters in the system are reset to zero.

Reset System Histograms

All histograms are reset, and the calculation period is restarted.

7.6.1 Detailed Counters

The Detailed Counters page (Figure 54) displays detailed statistics of the Ethernet Bridge and the underlying wireless performance.

Figure 54 - Detailed Counters Page

Detailed Counters

Ethernet			Wireless		
Attributes	**Value**	**Units**	**Attributes**	**Value**	**Units**
Ethernet Rx Octets	279,468 (+21,351)		Wireless Rx Octets	2,482 (+0)	
Ethernet Tx Octets	2,528,496 (+202,261)		Wireless Tx Octets	785,161 (+639)	
Ethernet Rx Drops	0 (+0)		Wireless Rx Drops	0 (+0)	
Ethernet Rx Packets	2,507 (+86)		Wireless Rx Packets	32 (+0)	
Ethernet Rx Broadcasts	244 (+25)				
Ethernet Rx Multicasts	14 (+0)				
Ethernet Rx Crc And Align	0 (+0)		Wireless Rx Crc And Align	0 (+0)	
Ethernet Rx Undersize	0 (+0)		Wireless Rx Undersize	0 (+0)	
Ethernet Rx Oversize	0 (+0)		Wireless Rx Oversize	0 (+0)	
Ethernet Rx Fragments	0 (+0)				
Ethernet Rx Jabbers	0 (+0)				
Ethernet Tx Drops	1 (+0)		Wireless Tx Drops	3,731 (+348)	
Ethernet Tx Packets	2,843 (+106)		Wireless Tx Packets	1,502 (+0)	
Ethernet Tx Broadcasts	1 (+0)				
Ethernet Tx Multicasts	2 (+0)				
Ethernet Tx Collisions	0 (+0)				
Ethernet Tx Fifo Drops	0 (+0)				
Ethernet Rx Frames Q0	2,538 (+226)		Wireless Tx Frames Q0	1,502 (+6)	
Ethernet Rx Frames Q1	0 (+0)		Wireless Tx Frames Q1	0 (+0)	
Ethernet Rx Frames Q2	0 (+0)		Wireless Tx Frames Q2	0 (+0)	
Ethernet Rx Frames Q3	0 (+0)		Wireless Tx Frames Q3	0 (+0)	
Ethernet Rx Frames Q4	0 (+0)		Wireless Tx Frames Q4	0 (+0)	
Ethernet Rx Frames Q5	0 (+0)		Wireless Tx Frames Q5	0 (+0)	
Ethernet Rx Frames Q6	0 (+0)		Wireless Tx Frames Q6	0 (+0)	
Ethernet Rx Frames Q7	0 (+0)		Wireless Tx Frames Q7	0 (+0)	
Ethernet Tx Frames Q0	2,878 (+257)		Wireless Rx Frames Q0	32 (+0)	
Ethernet Tx Frames Q1	0 (+0)		Wireless Rx Frames Q1	0 (+0)	
Ethernet Tx Frames Q2	0 (+0)		Wireless Rx Frames Q2	0 (+0)	
Ethernet Tx Frames Q3	0 (+0)		Wireless Rx Frames Q3	0 (+0)	
Ethernet Tx Frames Q4	0 (+0)		Wireless Rx Frames Q4	0 (+0)	
Ethernet Tx Frames Q5	0 (+0)		Wireless Rx Frames Q5	0 (+0)	
Ethernet Tx Frames Q6	0 (+0)		Wireless Rx Frames Q6	0 (+0)	
Ethernet Tx Frames Q7	0 (+0)		Wireless Rx Frames Q7	0 (+0)	
Ethernet Rx Pause Frames	0 (+0)				
Ethernet Tx Pause Frames	2 (+0)				
Internal Stack					
Packets To Internal Stack	2,286 (+97)				
Packets From Internal Stack	2,859 (+123)				
Packets Ignored By Internal Stack	0 (+0)				
Detailed Counters Page Refresh Period	3600	Seconds	Update Page Refresh Period	Reset System Counters	

The Detailed Counters page is subdivided into two columns. Column one presents the detailed statistics for the bridge's Ethernet interface. Column two relates to the wireless interface.

The Counters have the following definitions:

Tx & Rx Octets
Total number of octets (bytes) transmitted or received over the interface.

Rx Drops
Total number of frames dropped due to the lack of sufficient capacity in the receive buffer.

Rx Packets
Total number of packets received by the interface. This includes both good and bad packets.

Rx Broadcasts
Total number of good broadcast packets (Ethernet interface only).

Rx Multicasts
Total number of good multicast packets (Ethernet interface only).

Rx CRC and Align
Total number of packets with CRC or frame alignment errors.

Rx Undersize
Total number of packets received that are less than 64 bytes and have a valid CRC.

Rx Oversize
Total number of packets received that are greater than the maximum number of bytes with a valid CRC.

Rx Fragments
Total number of packets that are less than 64 bytes with an invalid CRC (these packet types are also known as runts) (Ethernet interface only).

Rx Jabbers
Total number of packets received that are greater than the maximum number of bytes with an invalid CRC (Ethernet interface only).

Tx Drops
Total number of frames dropped due excessive collisions, late collision and frame ageing.

Tx Packets
Total number of packets received by the interface. This includes both good and bad packets.

Tx Broadcasts
Total number of good broadcast packets (Ethernet interface only).

Tx Multicasts
Total number of good multicast packets (Ethernet interface only).

Tx Collisions
Total number frames experiencing collisions (Ethernet interface only).

Tx FIFO Drops

Total number frames dropped due to lack of capacity in the transmit buffer, for example when the PTP 500 Series bridge is connected to the local Ethernet at a connection speed of less than 100 Mbps (Ethernet interface only).

Rx & Tx Frames Q0…Q7

Total number of received or transmitted frames for each Traffic Class (Q0 to Q7).

Rx & Tx Pause Frames

Total number of received or transmitted pause frames (Ethernet interface only).

Packets To Internal Stack

The total number of good packets the bridge has transmitted to the internal stack.

Packets From Internal Stack

The total number of good packets the bridge has received from the internal stack

Packets Ignored By Internal Stack

The total number of bad packets the bridge has transmitted to the internal stack.

Statistics Page Refresh Period

The statistics page refreshes automatically according to the setting entered here (in seconds).

7.7 Installation Wizard

There follows a description of the installation wizard pages along with their use during the installation configuration process. The actual installation process is described in Section 7.7.2 “Manual Configur”.

NOTE

This section assumes that the integrated PTP 500 is being installed. If the connectorized variant is being installed, refer to Section 10.2 “Software/Features” for details of the additional functionality that must be configured.

7.7.1 Factory Configuration

All wireless links are shipped as paired units. They are pre-configured at the factory so that they can be installed without the user supplying any configuration. Each wireless link is shipped with a deployment guide. Attached to the deployment guide is a summary of the pre-configured configuration data. Table 12 shows a sample link configuration. The values in red type have been committed to the wireless unit’s non-volatile storage.

Table 12 – PTP 500 Series Bridge Factory Configuration Values

Example PTP 500 Series Configuration Data	
For your convenience these two units have been pre-configured as linked Units.	
Units:	
ODU serial number	ODU serial number
0167100000A0	016710000096
Ethernet MAC address	Ethernet MAC address
00:04:56:10:00:96	00:04:56:10:00:A0
Configured as:	
Master	Slave
Target MAC address	Target MAC address
00:04:56:20:00:05	00:04:56:20:00:0D
License Key	License Key
9eb8-c807-396c-7c3f-2819-393e-1f48-e46f	c49a-e2ac-9ca7-3925-e4e2-a8cc-120d-2f5e
IP Address	IP Address
169.254.1.2	169.254.1.1

⚠ CAUTION

The factory default configuration is set to Region 26. Region 26 allows the PTP 500 Series bridge a maximum transmit power of 27 dBm. If the local regulatory regime limits the maximum transmit power (EIRP) to less than 27 dBm you should obtain a new license key containing the correct region code from your local distributor or direct from Motorola. Alternatively in the short term, you should reduce the maximum transmit power by following the procedures in Section 7.7.2 'Manually Configuring The Wireless Units'.

7.7.2 Manual Configuration

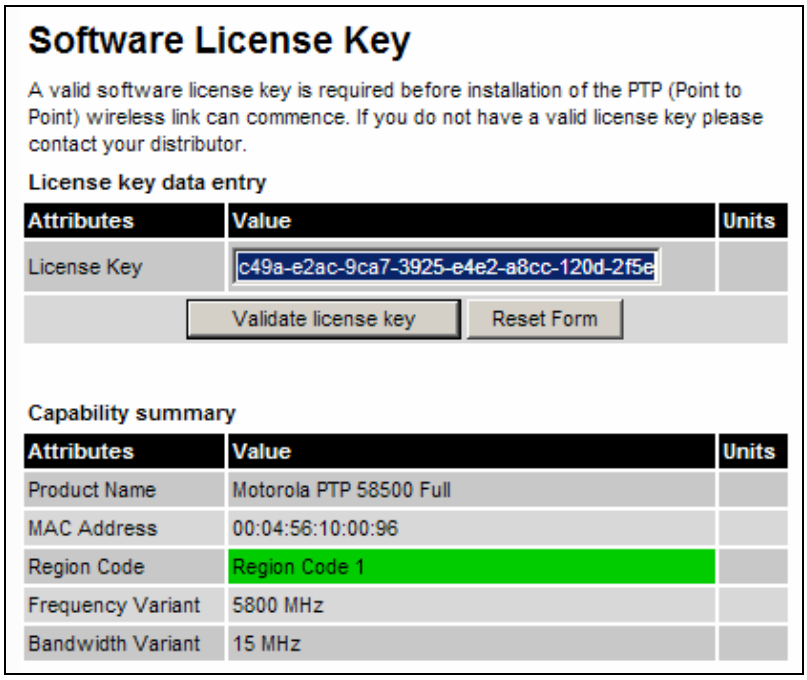
If the installer / system administrator wishes, they may modify the default installation configuration. If only the IP addresses (network configuration) are incorrect it is recommended that the values are changed via the configuration menu (Section 7.5.2 “LAN Configuration”).

NOTE

If any other parameters (for example Region Code) require modification, then it is recommended that the system administrator use the Installation Wizard.

The PTP 500 Series bridge operational software requires a license key (Figure 55) to enable the wireless bridging capability and programs region code specific parameters in to the unit.

Figure 55 - License Key Data Entry



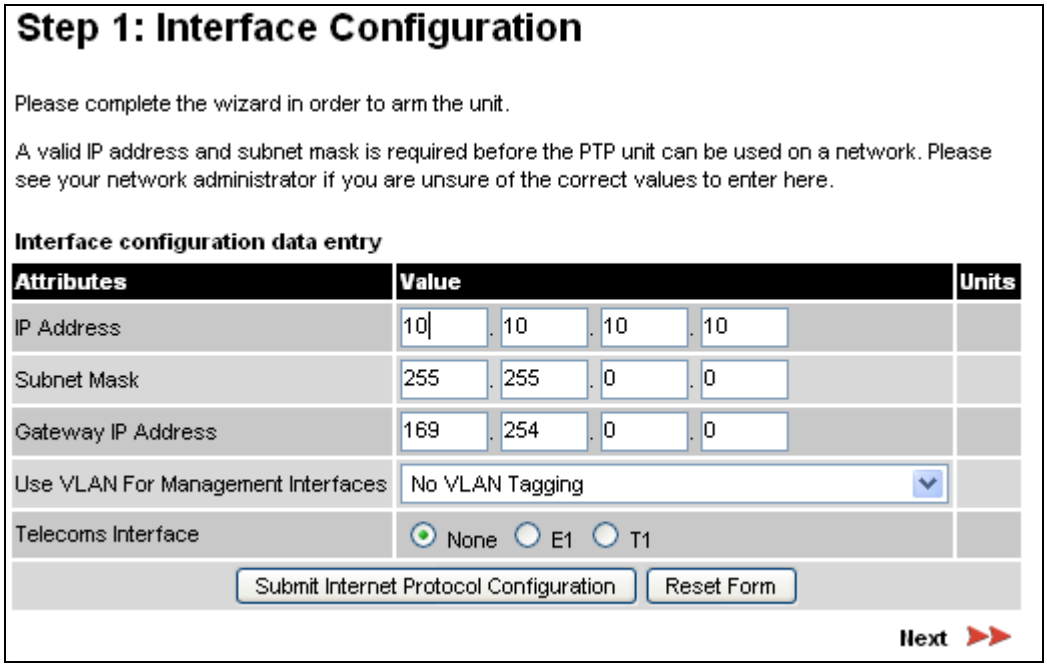
A license key is programmed into each unit during production and can be found written on the Configuration Data Summary Label which is attached to the Deployment Guide. If subsequently the license key has been mislaid, replacement keys can be applied for online or via your distributor.

If a valid license key is not detected in the unit's non-volatile memory then the user is prompted to enter a valid key. PTP 500 Series bridge units are shipped as link pairs and, as such, valid license keys are entered during the production process. To enter a license key, simply type or paste the license key into the data entry box (Figure 55) and click the 'validate license key' button.

7.7.3 Installation Wizard Step 1 - Interface Configuration

Step 1 of the installation wizard requires the installer to enter the Internet Protocol (IP) configuration (Figure 56).

Figure 56 - Installation Wizard Internet Protocol Configuration



The Interface Configuration page contains the following fields:

IP Address

Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.

Subnet Mask

A subnet allows the flow of network traffic between hosts to be segregated based on a network configuration. By organizing hosts into logical groups, subnetting can improve network security and performance.

Gateway IP Address

The IP address of a computer / router on the current network that acts as a gateway. A gateway acts as an entrance / exit to packets from / to other networks.

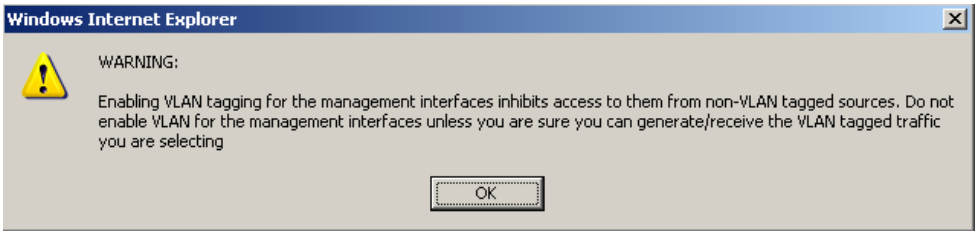
Use VLAN Management Interface

Controls whether the management interfaces (HTTP/SNMP/SMTP/SNTP) use a VLAN. Selecting this option presents the user with extra fields in which to enter the Management VLAN ID, Priority and whether to validate the VLAN ID. If the user modifies this control, a warning dialog is displayed see Figure 57.

Telecoms Interface

This allows the activation of the PTP 500 Series bridge telecoms interface. The selection options are None, E1 or T1.

Figure 57 - VLAN Warning

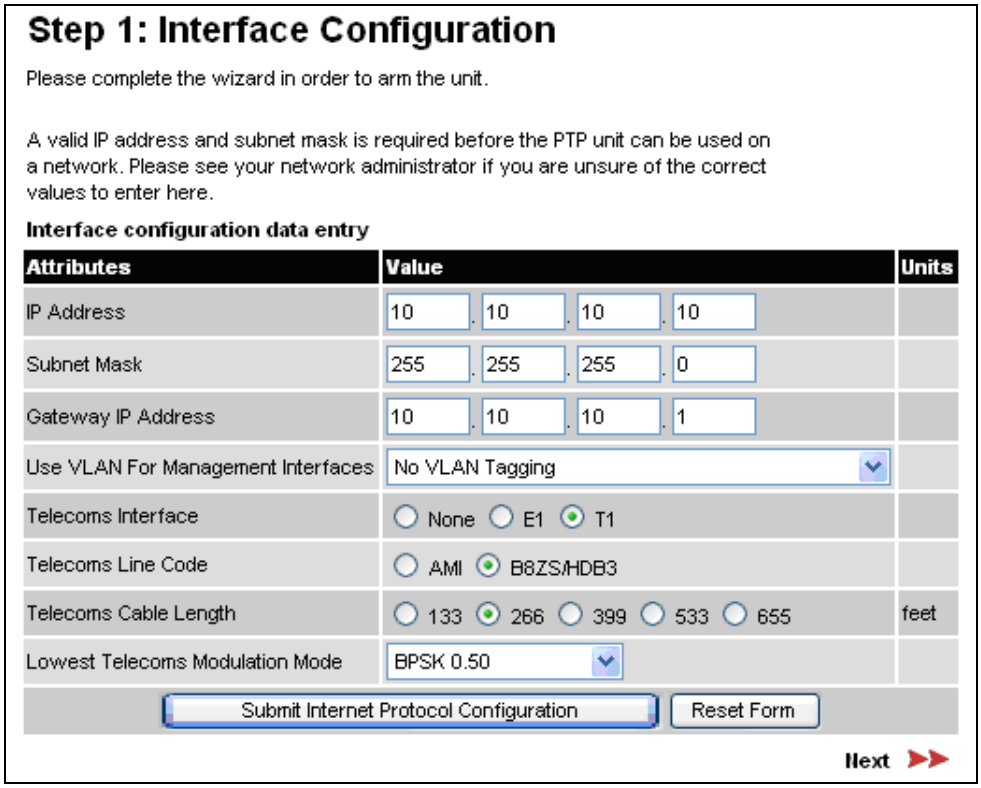


Once complete, click the ‘Submit Internet Protocol Configuration’ button or the ‘Next’ link.

7.7.3.1 Telecoms Interface

If the Telecoms Interface field is set to either T1 or E1, then Step 1 of the installation wizard contains additional configuration fields (Figure 58).

Figure 58 - Telecoms Configuration Interface



The additional E1 or T1 fields are:

Telecoms Line Code

The line code setting of the telecoms interface. This must match the setting of the device connected to this interface.

NOTE

If a copper loopback is used to test the E1/T1 link, ensure that the test set is configured manually. If the test set is allowed to configure automatically, neither it nor the ODU send a signal until they receive one, so the test appears to fail.

Telecoms Cable Length

This field is applicable to the T1 operating mode only. It configures the T1 transceiver to output a signal suitable for driving a cable of the specified length. This should be set to reflect the length of cable between the wireless unit and the connected equipment.

Lowest Telecoms Modulation Mode

The lowest modulation mode at which telecoms data will be sent, if there is sufficient link capacity.

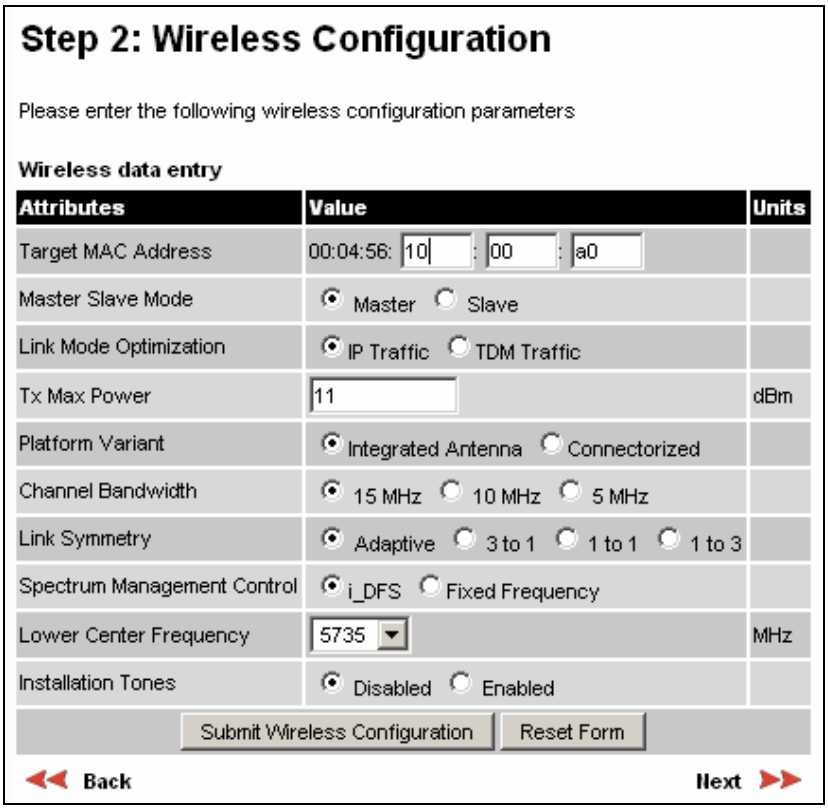
In conjunction with the LINKPlanner tool, this setting may be used to optimize the latency for links which operate in consistently high modulation modes. High data rate links are able to support lower latencies.

The lowest telecoms modulation mode is selected from a rate ordered drop-down list. If this selected mode has insufficient capacity to support the telecoms data then the effective lowest modulation mode, determined when the wireless link starts, will be higher. The effective lowest modulation mode is displayed on the Telecoms Configuration page.

7.7.4 Installation Wizard Step 2 - Wireless Configuration

Step 2 of the installation wizard requires the installer to enter the wireless configuration parameters. Figure 59 is an example of the Wireless Configuration screen.

Figure 59 –Wireless Configuration



Screen contents vary depending upon the options selected as follows:

- If Spectrum Management Control is set to “Fixed Frequency”, the Lower Center Frequency field is replaced by Fixed Tx Frequency and Fixed Rx Frequency.
- If Platform Variant is set to “Connectorized”, Antenna Gain and Cable Loss are also displayed. For more information about the configuration of connectorized PTP 500 units, refer to Section 10.2 “Software/Features”.

The Wireless Configuration page contains the following fields:

Target MAC Address

This is the MAC Address of the peer unit that will be at the other end of the wireless link. This is used by the system to ensure the unit establishes a wireless link to the correct peer. The MAC Address can be found embedded within the serial number of the unit. The last six characters of the serial number are the last three bytes of the unit's MAC address.

NOTE

A PTP 500 Series system is shipped as a pair of units with pre-loaded correct MAC addresses. Target MAC addresses will only need to be entered if an existing unit has to be replaced in the field or the units configuration has been erased.

Master Slave Mode

At this point it is necessary to decide which end will designate a Master. The Master unit is the controlling unit with respect to the point-to-point link and its maintenance. The master transmits until the link is made, while the Slave listens for its peer and only transmits when the peer has been identified.

Link Mode Optimization

Optimizes the link behavior according to the type of traffic that will be bridged. There are two modes to choose from: IP and TDM. For more information, see 3.8 "Link Mode Optimization".

Tx Max Power

This attribute controls the maximum transmit power the unit is permitted to use when installing and executing the wireless link. The maximum setting for a particular region or country is controlled by the License Key.

Platform Variant

Chooses between an integrated unit or a connectorized unit that requires an external antenna.

Channel Bandwidth

Users can choose a variable channel bandwidth for the available spectrum. Values of 5 MHz, 10 MHz and 15 MHz can be selected.

Link Symmetry

(Master only) Values of "Adaptive", "3 to 1", "1 to 1" and "1 to 3" can be selected. The adaptive setting allows link symmetry to vary dynamically in response to offered traffic load. The remaining values select three options for fixed division between transmit and receive time in the TDD frame of the master ODU. The first number in the ratio represents the time allowed for the transmit direction and the second number represents the time allowed for the receive direction.

The appropriate matching Link Symmetry is set at the slave ODU automatically. For example, if Link Symmetry is configured as "3 to 1" at the master ODU, then the slave ODU will be set automatically as "1 to 3". In this example, the master-slave direction has triple the capacity of the slave-master direction.

Link Symmetry is subject to the following restrictions:

"Adaptive" is not supported in regions where radar avoidance is in use.

"Adaptive" is not supported when link optimization is set to "TDM".

"Adaptive" is not supported in 5 MHz channel bandwidth.

"3 to 1" and "1 to 3" are not supported in 5 MHz channel bandwidth.

“3 to 1” and “1 to 3” are not supported when E1/T1 services are enabled.

Spectrum Management Control

Is used to configure the PTP 500 Series Bridge’s Spectrum Management features, see Section 7.9 “Spectrum Management” for more details. In regions that do not mandate DFS (Radar Detection), the Spectrum Management Control options are “i-DFS” and “Fixed Frequency”. In regions that mandate DFS (Radar Detection), the Spectrum Management Control options are “DFS” and “DFS with i-DFS”.

Lower Center Frequency

Not displayed when Spectrum Management Control is set to “Fixed Frequency”. The software for the PTP 500 Series Bridge allows a user to optionally adjust the channel center frequencies. Changing the Lower Center Frequency attribute causes all channel center frequencies to be offset. It effectively slides the channelization up or down.

⚠ CAUTION

The lower center frequency attribute must be configured to the same value for both the master and slave. Failure to do so will cause the wireless link to fail reestablishment. The only way to recover from this situation is to modify the Lower Center Frequency attribute so that they are identical on both the master and slave unit.

Default Raster

If this is set to “On”, the list of options presented in the fixed Tx frequency box is limited by the default raster.

Fixed Tx Frequency, Fixed Rx Frequency

Only displayed when Spectrum Management Control is set to “Fixed Frequency”. The software for the PTP 500 Series Bridge allows a user to optionally fix the Transmit and the Receive frequencies for a wireless link. The settings must be compatible at each end of the link. Once configured, the spectrum management software will not attempt to move the wireless link to a channel with lower co-channel or adjacent channel interference. Therefore this mode of operation is only recommended for deployments where the installer has a good understanding of the prevailing interference environment.

Figure 60 shows an example fixed frequency configuration for a 15 MHz channel bandwidth. In this example, the Fixed Transmit Frequency is set to 5735 MHz and the Fixed Receive Frequency is set to 5735 MHz. Care must be taken when configuring the Fixed Transmit and Receive Frequencies to ensure that both frequencies are on the same channel raster as the Lower Center Frequency. For example, if the channel raster is 5 MHz, both the Fixed Transmit and Receive Frequencies must be a multiple of 5 MHz from the Lower Center Frequency (5740 = 5735 + 5 MHz) and (5745 = 5735 + 5 MHz x 2).

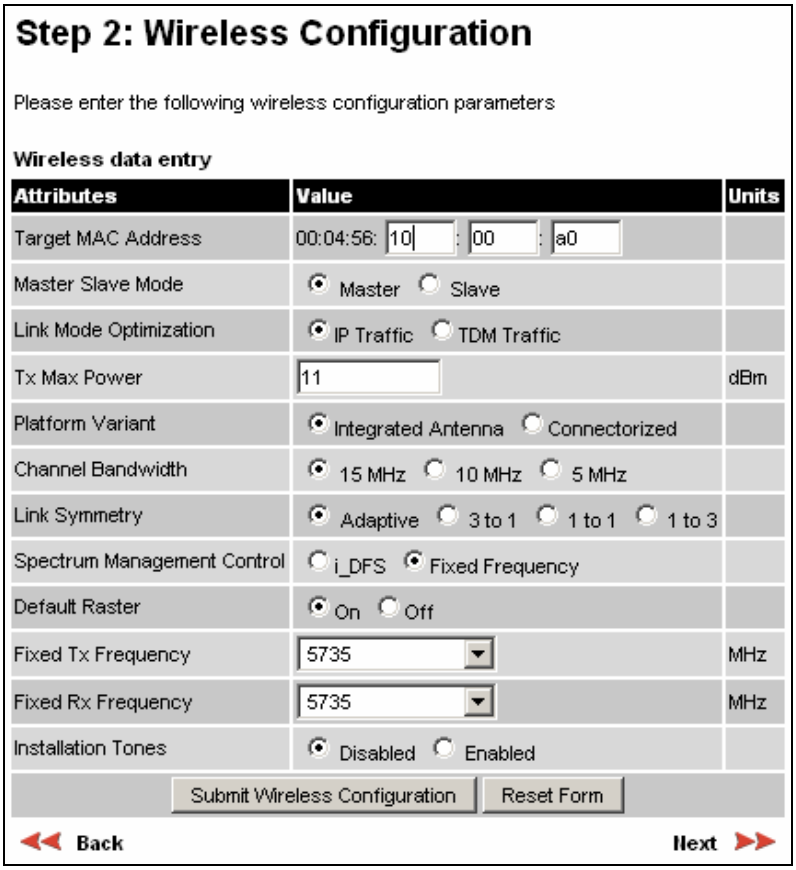
NOTE

A raster limits the selection of the Rx frequency based upon the setting of the Tx frequency.

Installation Tones

Where the use of audio installation tones is not required, this control allows the installer to optionally disable the tone generator during the installation process.

Figure 60 – Fixed Frequency Configuration Example



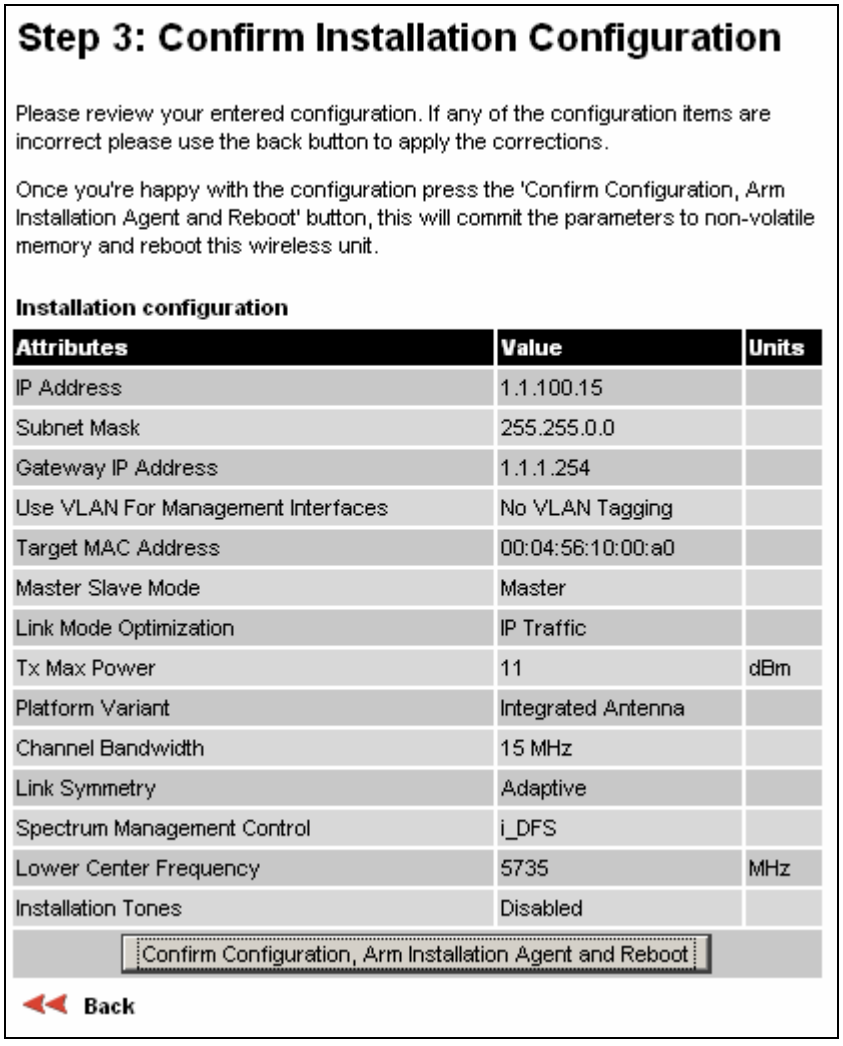
7.7.4.1 Submit Wireless Configuration

Once the installer is satisfied with the wireless configuration options then the **Submit Wireless Configuration** button or the **Next** link should be clicked.

7.7.5 Installation Wizard Step 3 - Confirm Configuration

Step 3 of the installation wizard requires the installer to confirm the wireless configuration parameters. Figure 61 is an example of the Confirm Configuration screen. The screen contents vary depending upon the product variant and configuration options selected.

Figure 61 – Installation Wizard Confirm Configuration



Step 3: Confirm Installation Configuration

Please review your entered configuration. If any of the configuration items are incorrect please use the back button to apply the corrections.

Once you're happy with the configuration press the 'Confirm Configuration, Arm Installation Agent and Reboot' button, this will commit the parameters to non-volatile memory and reboot this wireless unit.

Installation configuration

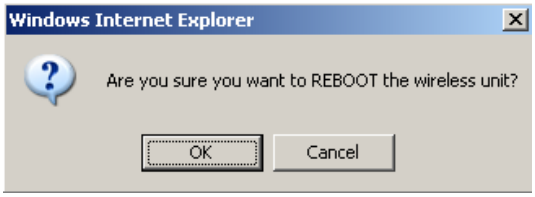
Attributes	Value	Units
IP Address	1.1.100.15	
Subnet Mask	255.255.0.0	
Gateway IP Address	1.1.1.254	
Use VLAN For Management Interfaces	No VLAN Tagging	
Target MAC Address	00:04:56:10:00:a0	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
Tx Max Power	11	dBm
Platform Variant	Integrated Antenna	
Channel Bandwidth	15 MHz	
Link Symmetry	Adaptive	
Spectrum Management Control	i_DFS	
Lower Center Frequency	5735	MHz
Installation Tones	Disabled	

Confirm Configuration, Arm Installation Agent and Reboot

Back

If the settings are correct and appropriate, click the “Confirm Configuration, Arm Installation and Reboot” button. The user will now be prompted to confirm the action (Figure 62).

Figure 62 - Reboot Confirmation Pop Up



All the attributes are committed to non-volatile memory. Immediately following the write to non-volatile memory the unit is reset.

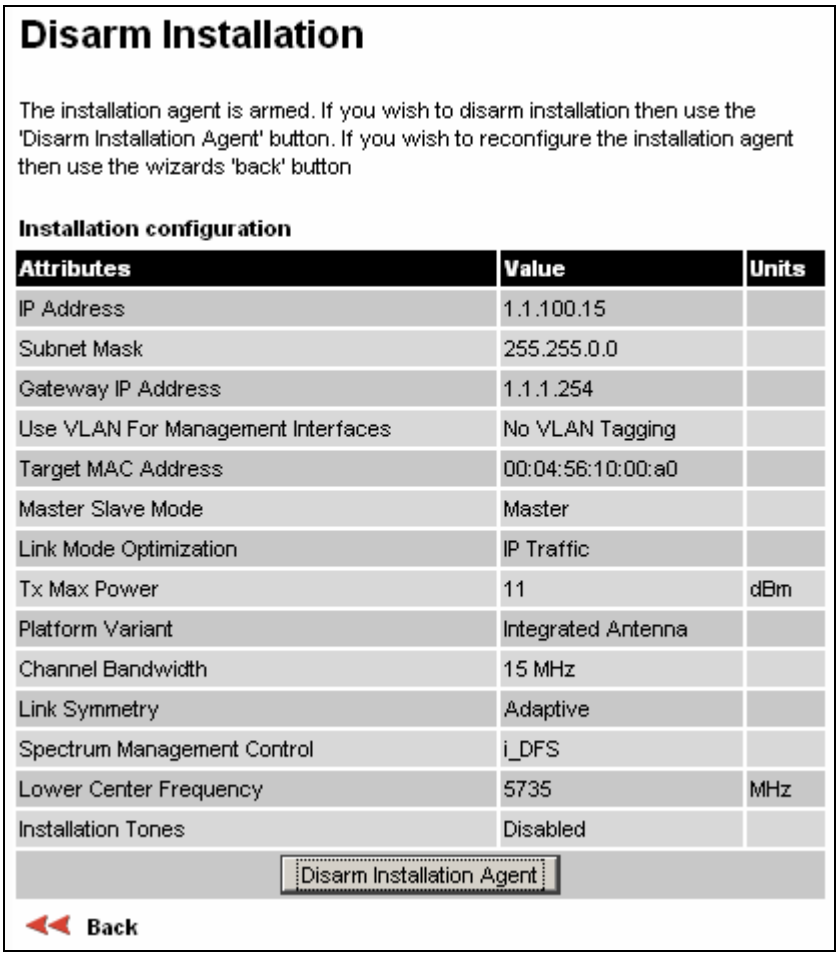
NOTE

If you have changed the Ethernet parameters you must reconnect using the correct network and address settings.

7.7.6 Disarm Installation

Figure 63 is an example of the Disarm Installation screen. The screen contents vary depending upon the product variant and configuration options selected.

Figure 63 – Disarm Installation

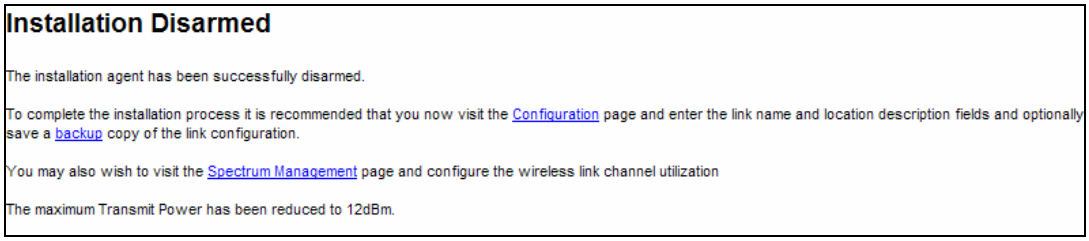


When Section 7.7.5 “Installation Wizard Step 3 - Confirm Configuration” is complete, the installation is armed and rebooted. Pressing the “Disarm Installation Agent” button completes the installation process and the audible installation tone will be switched off. If the installer wishes to modify the installation configuration then the ‘Back’ link can be used to access the installation wizard steps described above.

The installation process is completed when both ends of the link are ‘disarmed’.

After disarming the wireless link, the user is presented with message as shown in Figure 64. This message has been obtained when configuring the link with a Region Code where maximum power is used (Region Code of 1 and power of 27 dBm). The unit shows that the Transmit Power has been reduced to the lower operating power band. The screen presents hyperlinks to the main configuration and spectrum management pages.

Figure 64 - Optional Post Disarm Configuration



After installation the system administrator may wish to modify the wireless units descriptive configuration (link name and link location). In addition the system administrator may wish to change the spectrum management configuration of the wireless unit, or look at the analysis of the 5.8 GHz spectrum to see if the automatic channel selection is appropriate for the system administrator’s network. It is also recommended that a backup copy of the wireless units configuration is taken. Hyperlinks are provided on the post disarm page for ease of use.

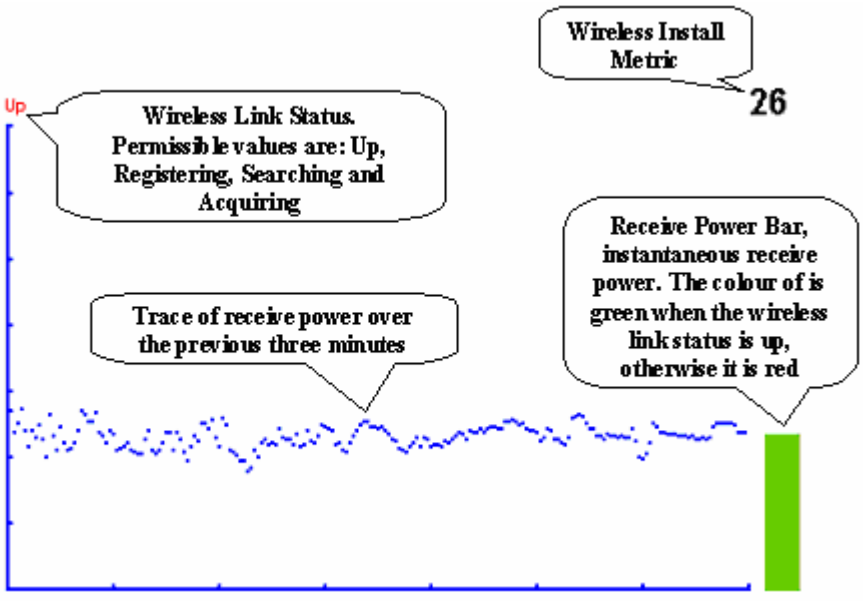
7.7.7 Graphical Install

To aid the installation of wireless links two graphical installation aids have been introduced in this PTP 500 Series system version.

- A PDA installation screen
- A larger installation screen available from the main HTTP management interface.

The design of the installation screen has been deliberately kept simple and uncluttered. An example of the installation screen is shown in Figure 65. Both the PDA and the large format installation screen have the same content and only differ in size. The PDA installation screen is 232 by 220 pixels to be compatible with the typical size of a PDA screen.

Figure 65 – Graphical Installation Screen



The screen displays the receive power over the last three minutes. This will allow the installer to slowly sweep the antenna during installation and monitor the variation in signal strength with angular position. The screen automatically refreshes every three seconds.

The screen also displays the current state of the wireless link in two ways. First, the actual state of the wireless link is written in the top left corner of the screen. The instantaneous receive power bar also encodes the state of the wireless link using green to signify that the wireless link is up and red for all other states.

The installation metric is simply the instantaneous receive power in dBm + 100.

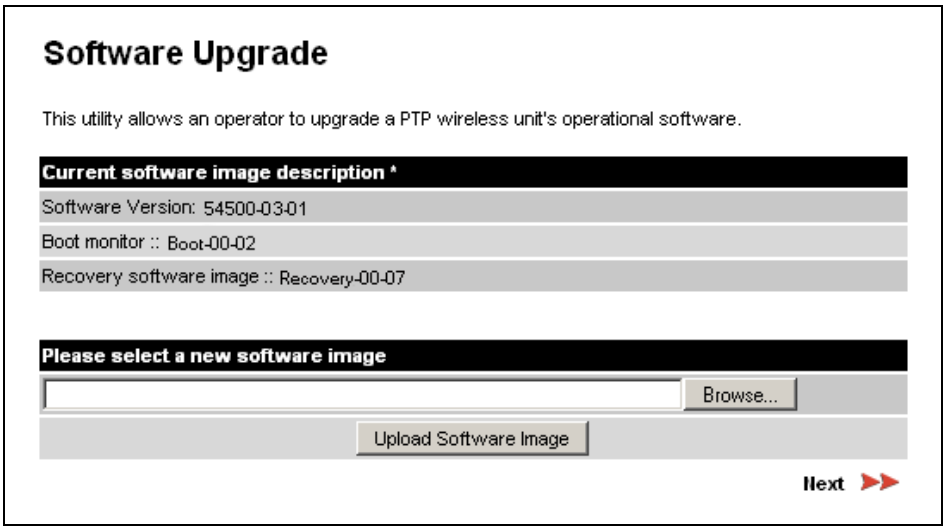
The PDA installation tool is accessed via a hidden URL http://<ip-address>/pda.cgi. It should be noted that this link is only available after the user has logged in as system administrator.

The large screen version of the graphical user interface is available as a submenu option of the installation wizard.

7.8 Software Upgrade

The PTP 500 Series system has two software image banks; one is a fixed image which is stored in protected non-volatile memory and cannot be modified by the user. The second bank is used by the system administrator to upgrade the firmware when necessary. Figure 66 shows the main software upgrade web page.

Figure 66 - Software Upgrade



The 'Fixed' or 'Recovery' image is used by the System Administrator to:

- Reset Ethernet configuration to default settings
- Erase Configuration
- Upgrade software

For a full description of the Recovery image see Section 8 "Recovery Mode".

The software upgrade pages are used to update a unit's operational software. The software image to be uploaded should be downloaded to local storage from the Motorola web site. The software image is delivered by Motorola as a compressed zip file. Once the zip file has been downloaded, the user should extract the PTP 500 Series Software image, identifiable by its '.dld' file extension.

7.8.1 Locate and Upload Software Image

The first step (Figure 66) is to use the "Browse" button to locate the software image previously downloaded to local storage from the Motorola web site. Once the image is located, the user should press the **Upload Software Image** button to start the software upgrade process.

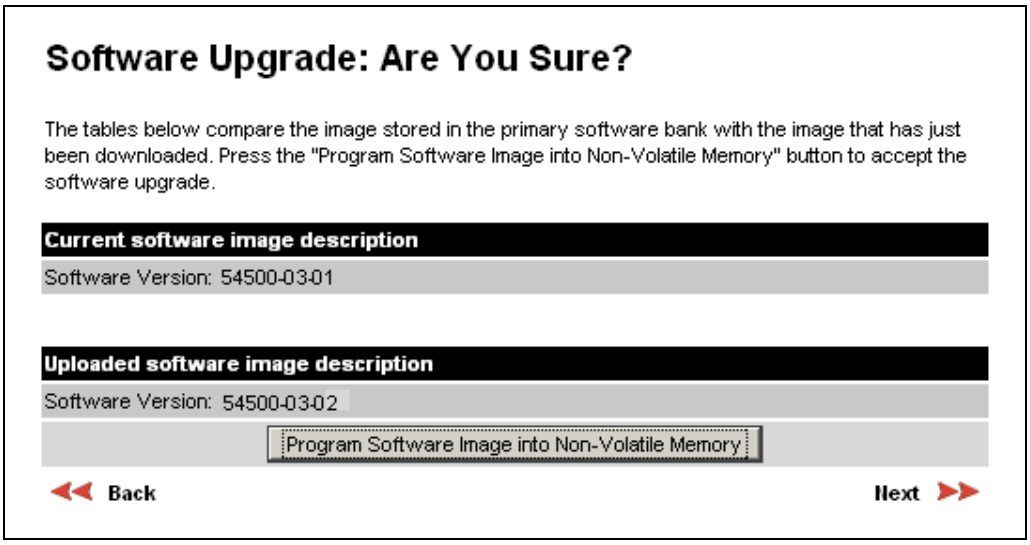
⚠ CAUTION

During the software upgrade process, ensure that the remote end is upgraded first using the wireless connection, and then the local end can be upgraded.

The software image will now be uploaded to the unit. This upload should only take a few seconds. Once complete the image is verified and validated to ensure that no errors occurred during transfer and that the image is valid to run on the current platform. If there are any problems a warning screen will appear.

The unit being upgraded will now display information about the build it currently has stored in the image bank and the one that's just been uploaded. If the image is not the right one, the user has the option to go back and reload a new image. (See Figure 67).

Figure 67 - Software Upgrade Image Check



7.8.2 Program Software Image into Memory

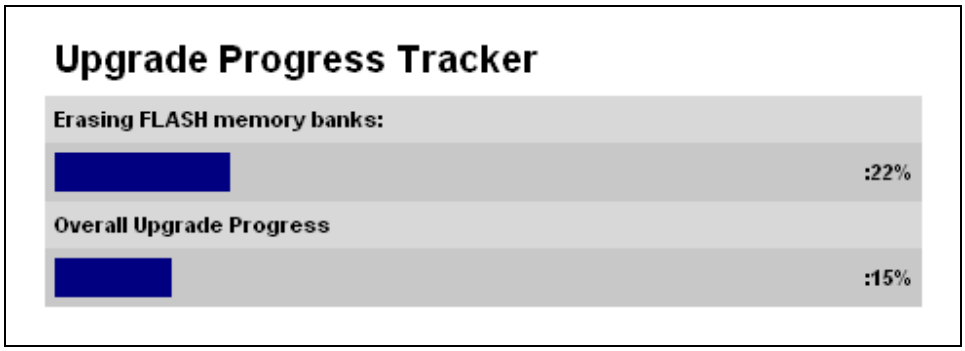
The user should ensure that the correct image is shown before pressing the “Program Software Image into Non-Volatile Memory” button. Once this button has been pressed the image is stored into non-volatile memory, this process can take up to 60 seconds and must not be interrupted.

⚠ CAUTION

If the upgrade process is interrupted during the erasure of the image bank, or during the reprogramming of the image bank, the image bank will be left in a corrupt state. If this occurs the software must be reloaded. All software images that are stored in non-volatile memory are protected via the use of CRCs. If the software detects an invalid CRC the image bank is marked as ‘corrupt’ and the PTP 500 Series bridge boot code will boot the fixed software image. If this occurs the user must attempt to reload the correct version of software.

During the write process the progress of the upgrade is displayed on the progress tracking page (Figure 68). The upgrade process should not be interrupted. Interruption of this process can result in a corrupt main software image, which will result in the recovery image been booted at the next reset cycle.

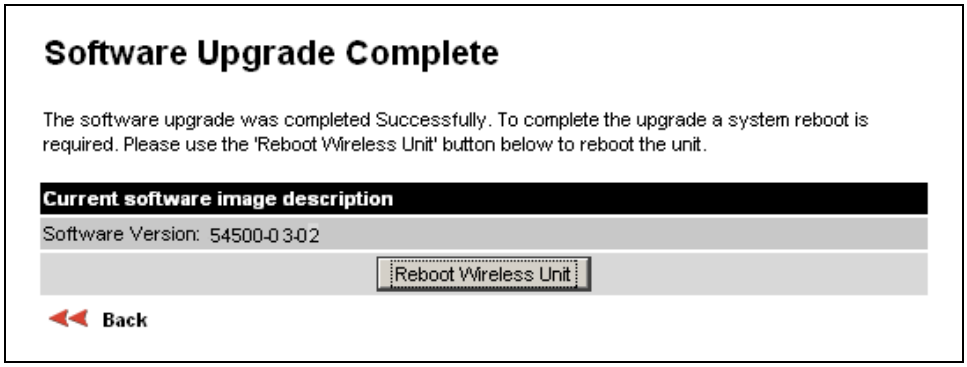
Figure 68 - Software Download Progress Indicator



7.8.3 Software Upgrade Complete

When the software image has been written to non-volatile memory, Figure 69 is displayed showing the status of the software upload.

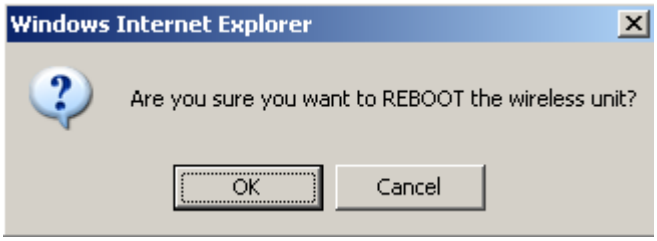
Figure 69 - Software Upgrade Complete Page



7.8.4 Reboot After Software Upgrade

Reboot the unit by clicking the “Reboot Wireless Unit” button. You will be asked to confirm this action as shown in Figure 70.

Figure 70 - Reboot Confirmation Pop Up



This will reboot the unit, taking up to 120 seconds. During this time you will not be able to communicate with the unit.

If you cannot communicate with the unit after 120 seconds, this could indicate a problem with the memory update process. Under these circumstances the user should enter “Recovery Mode”, see Section 8 “Recovery Mode”.

After the reboot the user should check that the required software image is loaded and running.

NOTE

Please ensure that you are upgrading the correct units. Units cannot be downgraded.

7.9 Spectrum Management

Spectrum Management Selection is the PTP 500 Series Bridge feature that monitors the available wireless spectrum and directs both ends of the wireless link to operate on a channel with a minimum level of co-channel and adjacent channel interference.

7.9.1 Wireless Channels

The PTP 500 Series Bridge operates using a set of predefined overlapping channels. There are a different number of channels, depending on the raster mode selected. Each channel occupies 15 MHz, 10 MHz or 5 MHz of wireless spectrum and is offset in center frequency from its neighboring channel by 5 MHz. It is important to note that adjacent channels on the Spectrum management display have a 5 MHz overlap to the adjacent channel.

The default channelization can be modified by varying the lower center frequency attribute in the installation wizard, as described in Section 7.7.4 “Installation Wizard Step 2 - Wireless Configuration”.

7.9.2 Spectrum Management Measurements

Each end of the PTP 500 Series Bridge performs a single measurement of the combined receiver input power in an inactive portion of the TDD cycle. The measurement is made with an effective bandwidth of 15 MHz, 10 MHz or 5 MHz on a single channel and includes the contribution from receiver noise.

The Spectrum Management algorithm collects measurements equally from all channels.

This process is called the Channel Availability Check (hereafter referred to by the acronym CAC).

The CAC uses a round-robin channel selection process to collect an equal amount of measurements from each channel. It is important to note that the CAC measurement process is not altered by the channel barring process. Measurements are still collected for all channels irrespective of the number of barred channels.

7.9.3 Measurement Analysis

Spectrum Management uses statistical analysis to process the received peak and mean measurement. The statistical analysis is based on a fixed, one minute, measurement quantization period. Spectrum Management collects data for the specified quantization period and only at the end of the period is the statistical analysis performed.

The analysis produces three key metrics for each channel:

Peak of Means

This is the largest mean interference measurement encountered during the quantization period. The peak of means is similar to the peak of peaks and is useful for detecting slightly longer duration spikes in the interference environment.

99.9% Percentile of the Means

This is the value of mean interference measurement which 99.9% of all mean measurements fall below, during the quantization period. The 99.9% percentile metric is useful for detecting short duration repetitive interference that by its very nature has a minimal effect of the mean of means.

Mean of Means

This is the arithmetic mean of the measured means during a quantization period. The mean of means is a coarse measure of signal interference and gives an indication of the average interference level measured during the quantization period. The metric is not very good at predicting intermittent interference and is included to show the spread between the mean of means, the 99.9% percentile and the peak of means.

NOTE

The arithmetic mean is the true power mean and not the mean of the values expressed in dBm.

Spectrum Management uses the 99.9% percentile as the prime interference measurement. All subsequent references to interference level refer to this percentile measurement.

The display of statistical measurement on the spectrum management page always shows a statistical summary of all channel measurement. The statistical summary is controlled by the Statistics Window attribute. This attribute defaults to a value of twenty minutes, which means that the mean and percentile values displayed for each channel are calculated over the 20 minute period. All channel decisions are made using the values computed over the statistics window period.

7.9.4 The Spectrum Management Master / Slave Relationship

The Spectrum Management operates in a master / slave relationship. The master is assumed to be the link master configured during installation. All Spectrum Management configuration changes MUST be performed from the master. To enforce this, the Spectrum Management web page has a different appearance depending if you are viewing the data from the master or slave.

All configuration changes are applied at the master only. These changes are then messaged from the master to the slave. Any Spectrum Management configuration messages received at the slave are stored in non-volatile memory. This enables both master and slave to keep identical copies of Spectrum Management configuration data in their non-volatile memories. It is therefore possible to swap master and slave roles on an active Point-to-Point link without modifying Spectrum Management configuration.

Figure 71 shows an example Spectrum Management webpage as seen from the master.

Figure 72 shows an example Spectrum Management webpage as seen from the slave. It should be noted that the key configuration attributes are not available on the slave web page.

NOTE

These examples are for 15 MHz operation; other channel bandwidths are similar. The width of the vertical green bar represents the channel width.

Figure 71 - Spectrum Management as seen from the Master

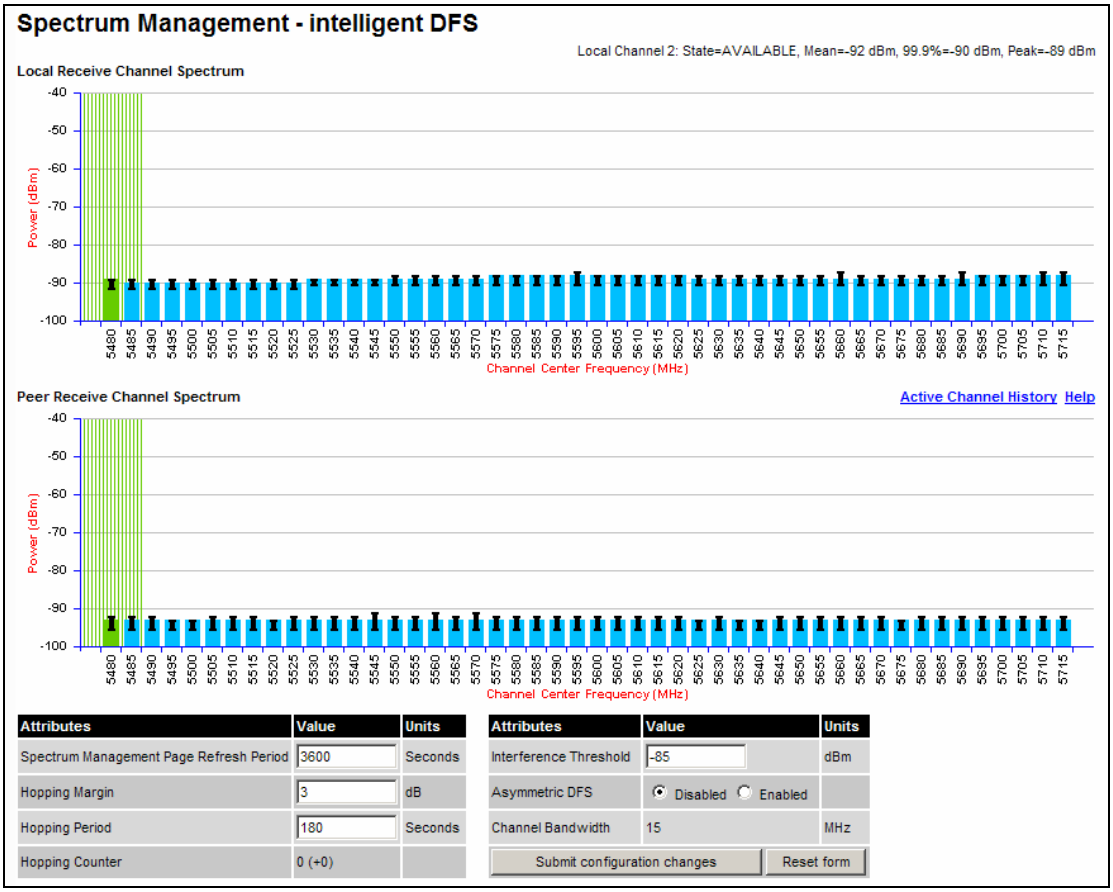
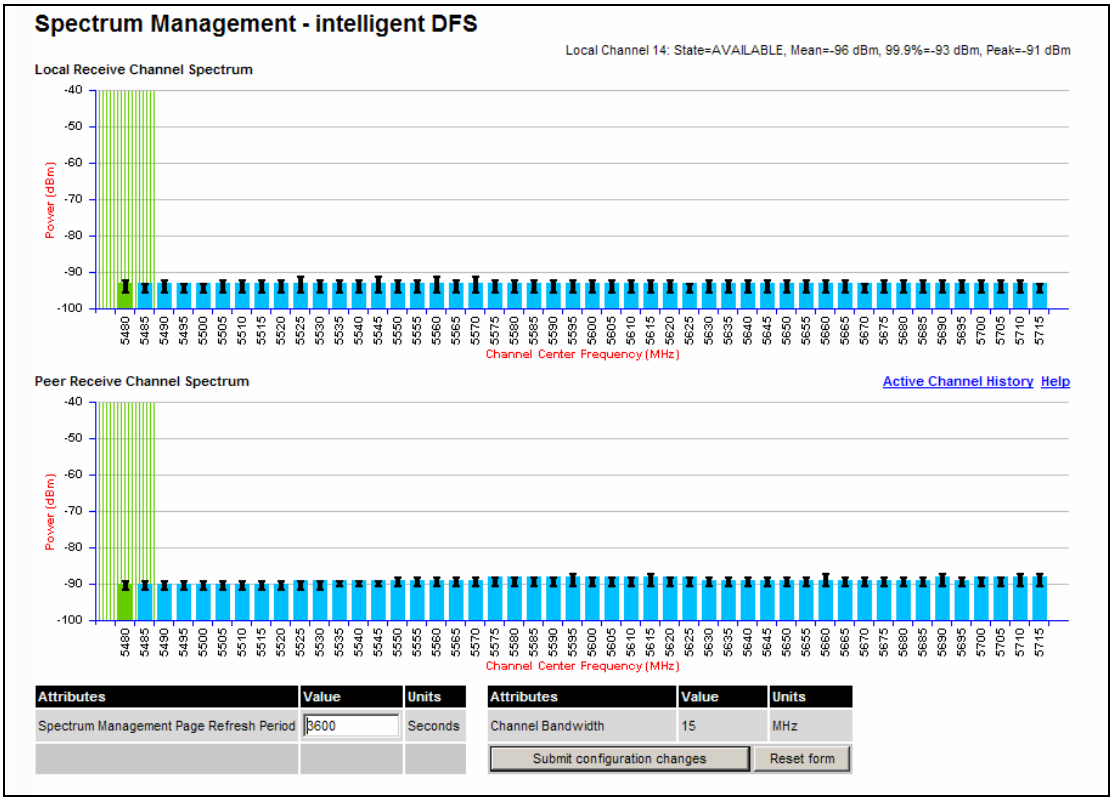


Figure 72 - Spectrum Management as seen from the Slave



7.9.5 Spectrum Management Configuration

The following section describes the user modifiable configuration accessible from the Spectrum Management webpage (Figure 71). It is recommended that the default values are maintained. If the user believes that the performance of the Spectrum Management algorithm requires some modifications this should only be done after consulting the Motorola Point-to-Point distributor or one of the system field support engineers.

The Spectrum Management page contains the following fields:

Page Refresh Period

The page refreshes automatically according to the setting entered here (in seconds).

Hopping Margin

Spectrum Management uses this margin when making a channel hop decision. If the interference level of the target channel is lower than that of the active channel by at least the Hopping Margin, the link will hop to the target channel. The default setting is 3 dB in non-radar regions, or 10 dB in radar regions.

Asymmetric DFS

Only displayed in non-radar regions when i-DFS is enabled. The default configuration of symmetric operation constrains the link to operate symmetrically, using the same transmit and receive channels. When in symmetric mode the slave unit will always follow the master. If the master moves to a new channel the slave will hop to the same channel. When the Point-to-Point link is configured as an asymmetric link both the master and slave are free to select the best channel from their own set of local interference metrics.

Spectrum Management Control

Only displayed in radar regions. The options are “DFS” and “DFS with i-DFS”

Hopping Period (not configurable)

The Spectrum Management algorithm evaluates the metrics every ‘Hopping Period’ seconds (180 seconds by default) looking for a channel with lower levels of interference. If a better channel is located, Spectrum Management performs an automated channel hop. If SNMP or SMTP alerts are enabled an SNMP TRAP or an email alert is sent warning the system administrator of the channel change.

Hopping Counter

This is used to record the number of channel hops. The number in the “(+)” brackets indicates the number of channel changes since the last screen refresh.

Interference Threshold

Spectrum Management uses the interference threshold to perform instantaneous channel hops. If the measured interference on a channel exceeds the specified threshold, then i-DFS will instruct the wireless to immediately move to a better channel. If a better channel cannot be found the PTP 500 Series Bridge will continue to use the current active channel. (Default – 85 dBm).

Channel Bandwidth (not configurable)

This shows the value of the variable channel bandwidth selected.

7.9.6 Barring Channels

Channels can only be barred / unbarred by the system administrator from the master Spectrum Management web page. The barring / unbarring operations are disabled on the slave web page. If an attempt to bar / unbar a channel is made at the slave, a warning dialog is generated.

Barring/Unbarring of channels is performed by clicking the appropriate channel on the local or peer channel spectrum plots on the master web page. Each bar / unbar attempt will be proceeded by a confirmation dialog. It should be noted that the channel bar will take effect immediately and is not related to the measurement quantization period.

7.9.7 Master and Slave Channel Spectrum Graphics

Spectrum Management presents its computed statistical measurements in a graphical display on both the master and slave Spectrum Management web page. See Figure 71 for an example.

The X-axis shows a stylized view of the wireless channels. It is important to note that adjacent channels on the display have a 10 MHz overlap. The display separates the display of channels to help the clarity of the resultant display. The axis is labeled using the channel center frequencies in MHz.

The Y-axis shows the interference power levels from –100 to –40 dBm.

The active channel is always marked using hatched green and white lines. The width of the hatching is directly proportional the channel bandwidth spectral occupancy of the channel.

The individual channel metrics are displayed using a colored bar and an ‘I’ bar.

The colored bar represents the following channel state:

Table 13 - Spectrum Management change state key

Green	Active	The channel is currently in use, hosting the Point-to-Point wireless link
Orange	Interference	The channel has interference above the interference threshold
Blue	Available	The channel has an interference level below the interference threshold and is considered by the Spectrum Management algorithm suitable for hosting the Point-to-Point link
Grey	Barred	The system administrator has barred this channel from use. For improved visibility, an additional red 'lock' symbol is used to indicate that a channel is barred.

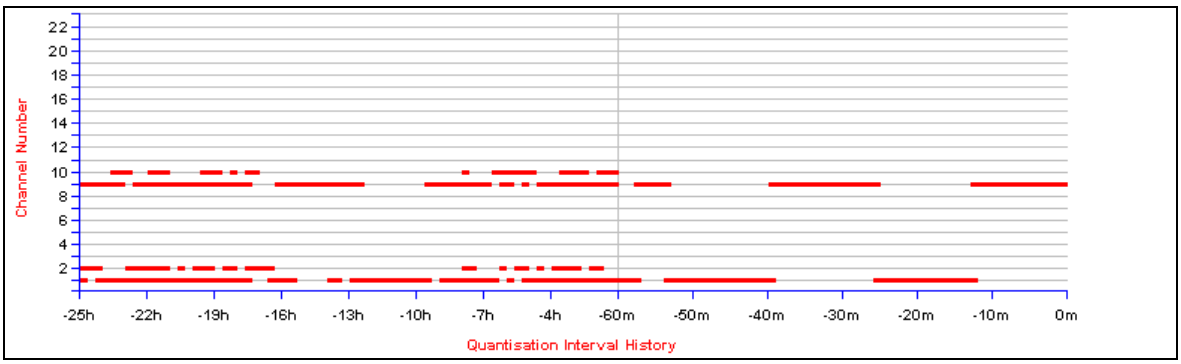
The top of the colored bar represents the 99.9% percentile metric for specific channel.

The 'I' Bar is used to display the mean of means and peak of means metrics. The lower horizontal bar represents the mean of means and the upper horizontal bar represents the peak of means. The vertical bar is used as a visual cue to highlight the statistical spread between the peak and the mean of the statistical distribution.

7.9.8 Active Channel History

The active channel history is a time series display of the channels used by the PTP 500 Series Bridge over the last 25 hours. The active channel history is activated from the main Spectrum Management page using the 'Active Channel History' hyperlink. An example of the active channel history display is shown in Figure 73. Where there are parallel entries on the display this signifies that the wireless link occupied this channel during the measurement period. The measurement periods are one minute (from zero to sixty minutes) and twenty minutes from (60 minutes to twenty five hours).

Figure 73 - Active Channel History Screen



7.9.9 Viewing Historic Spectrum Management Metrics

Spectrum Management allows the system administrator to view the results of previous measurement quantization periods. Holding down the shift key and clicking the appropriate channel on the local channel spectrum plots activates this feature. This feature is available on both the master and slave web page.

Figure 74 - Spectrum Management Time Series Plot

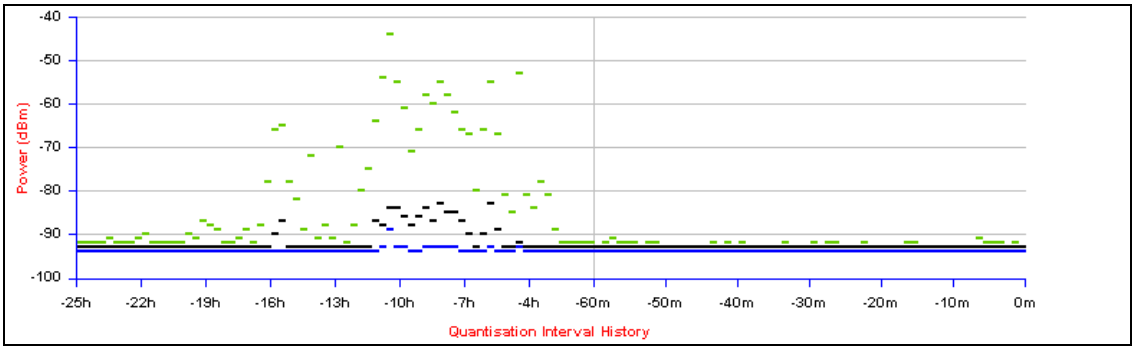


Figure 74 shows an example time series plot. A time series plot displays the previous 132 measurement quantization periods. If the PTP 500 Series Bridge has not been running for 132 quantization periods then only the number of measurement quantization periods that are available are displayed.

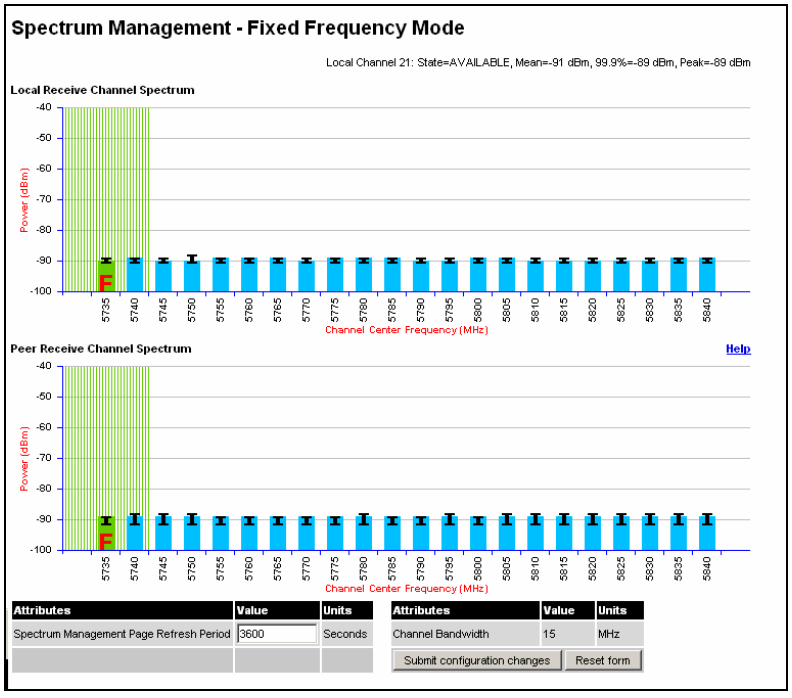
Table 14 - Spectrum Management Time Series Key

GREEN	Peak of Means interference measurement
BLACK	99.9% percentile of means interference measurement
BLUE	Mean of Means interference measurement

7.9.10 Spectrum Management (Fixed Frequency)

The PTP 500 Series Bridge software allows a user to optionally fix transmit and receive frequencies for a wireless link. Once configured, the spectrum management software will not attempt to move the wireless link to a channel with lower co and adjacent channel interference. Therefore this mode of operation is only recommended for deployments where the installer has a good understanding the prevailing interference environment. (See Section 7.7.4 “Installation Wizard Step 2 - Wireless Configuration”). Care must also be taken to ensure that the frequency allocations at each end of the link are compatible. To help the user when identifying the mode of operation Spectrum Management uses two visual cues. See Figure 75. The main page title identifies the mode of operation using the “Fixed Frequency Mode” postfix and the selected channels are identified by a red capital ‘F’.

Figure 75 - Spectrum Management Fixed Frequency Screen



Channel barring is disabled in fixed frequency mode; it is not required as dynamic channel hopping is prohibited in this mode.

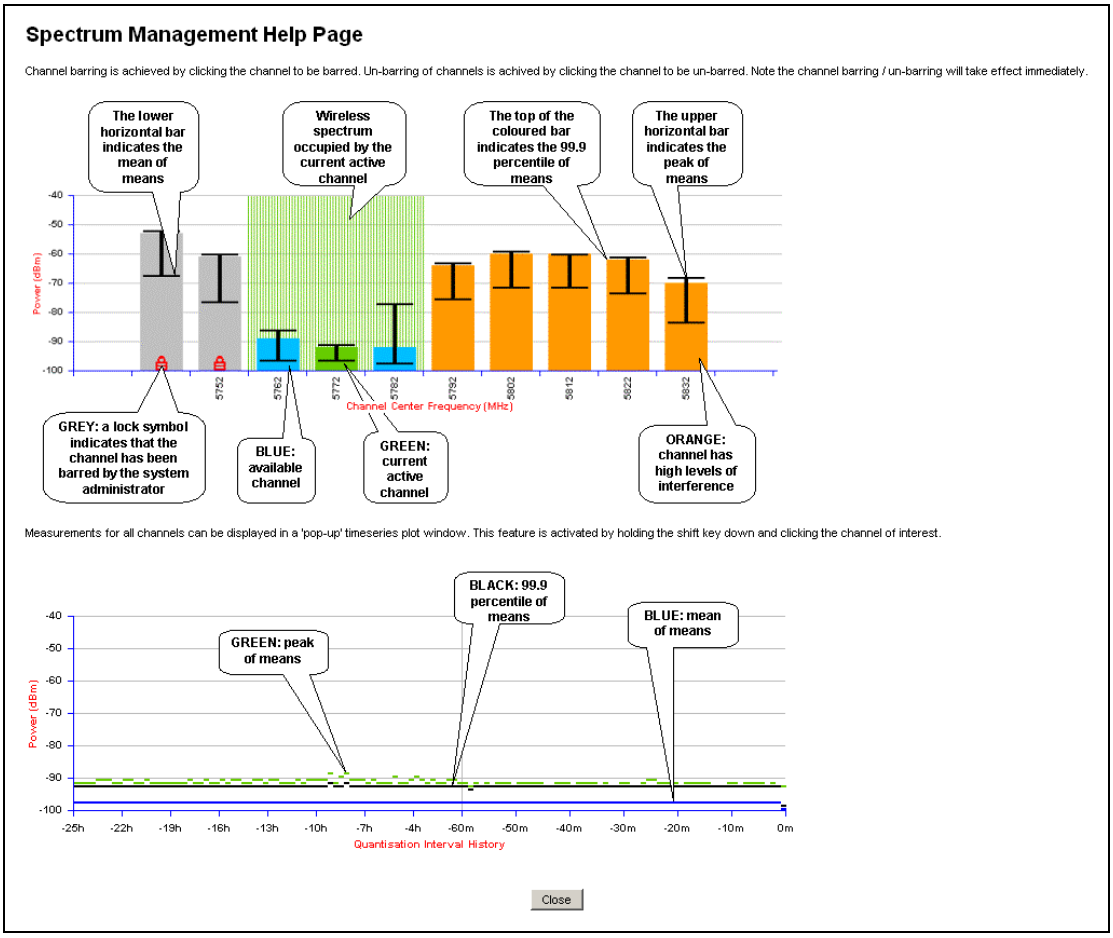
NOTE

These plots are for 15 MHz operation; 5 MHz and 10 MHz operation is similar - the width of the vertical green bar represents the channel width.

The only controls available to the master are the Statistics Window and Interference Threshold attributes. They will have no effect on the operation of the wireless link and will only effect the generation of the channel spectrum graphics.

The active channel history menu is removed in this mode of operation as channel hopping is prohibited.

Figure 76 - Spectrum Management Help Page (Fixed Frequency)



7.9.11 Spectrum Management Control with Radar Avoidance

When operating with Radar Avoidance enabled the following variances in operation apply:

- The words “Radar Avoidance” are appended to the “Spectrum Management” title at the top of the screen. See Figure 77 and Figure 78.
- The only controls available to the master are the Interference Threshold attribute. This has no effect on the operation of the wireless link and will only affect the generation of the channel spectrum graphics. See Figure 77.
- Extra color coding of the interference histogram is provided. See Table 15.

When operating with RTTT (Road transport and Traffic Telematics) Avoidance enabled or other regulatory restrictions on channel usage the following variances apply:

- All channels marked with a ‘no entry’ symbol with their associated statistics colored black are the prohibited channels. See Figure 77 and Figure 78. These channels are never used to host the wireless link, but CAC measurements are still taken so that adjacent channel biases can be calculated correctly and so the user can see if other equipment is in use.

Figure 77 - Spectrum Management Master Screen With Operational Restrictions

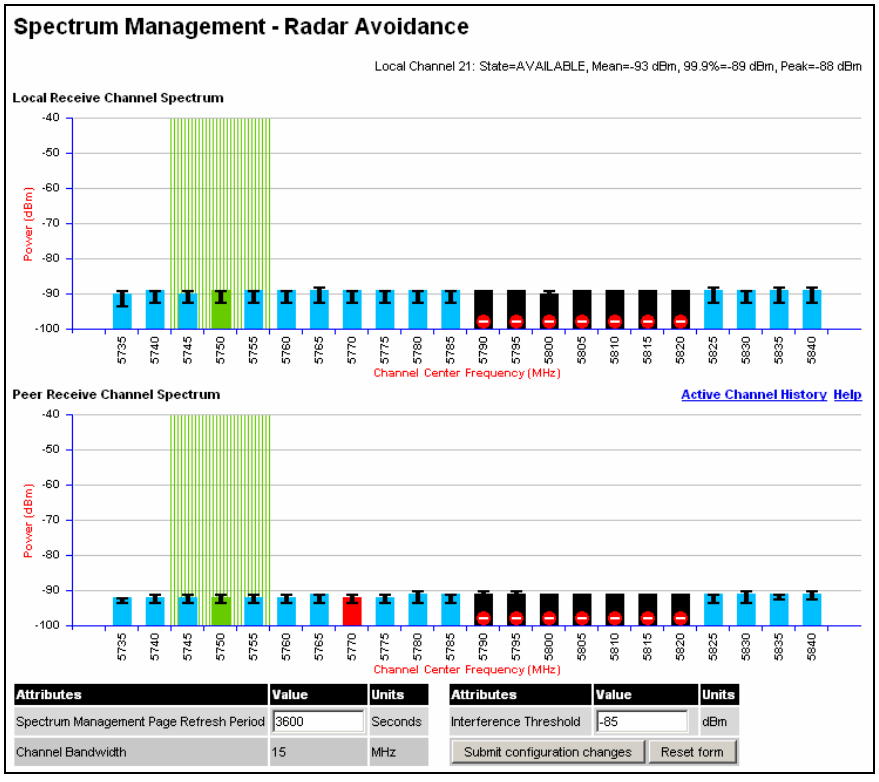
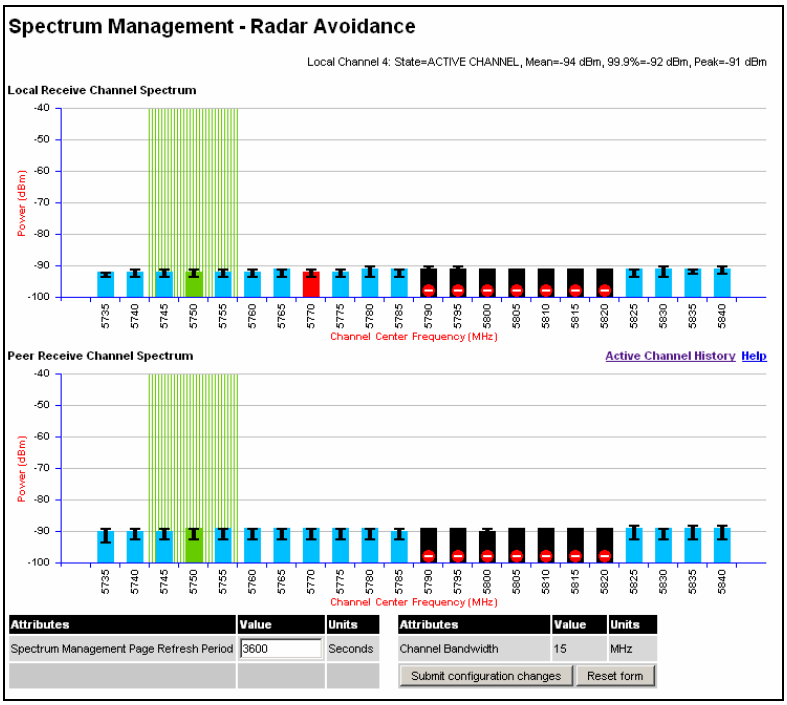


Figure 78 - Spectrum Management Slave Screen With Operational Restrictions



The colored bar represents the following channel state:

Table 15 - Spectrum Management Change State Key With Operational Restrictions

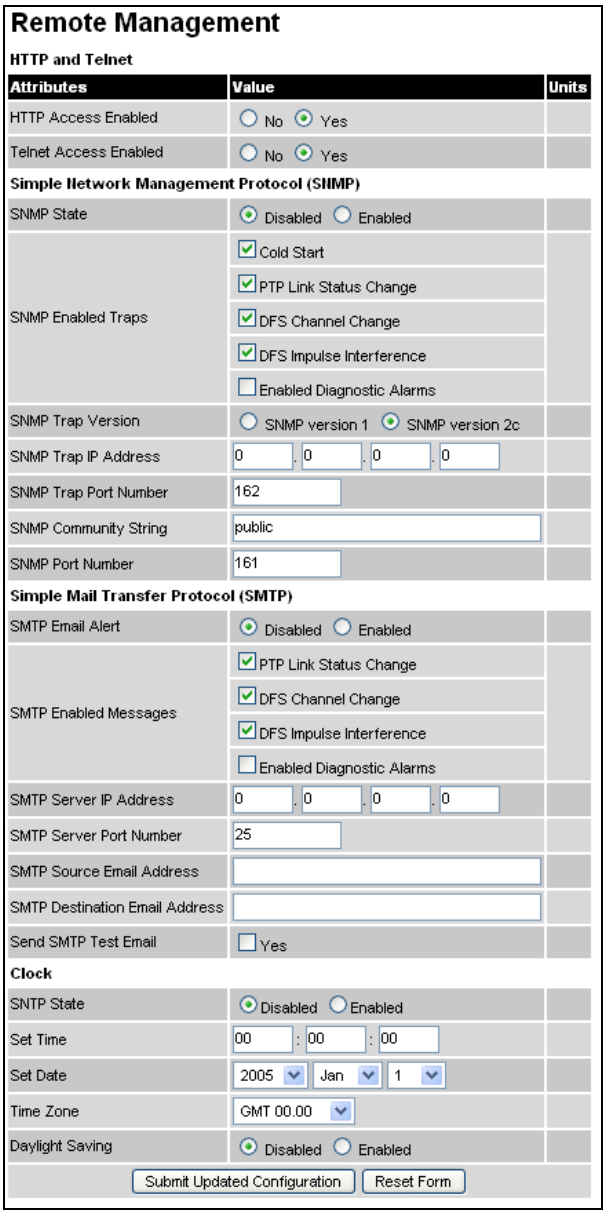
Green	Active	The channel is currently in use hosting the Point-to-Point wireless link
Orange	Interference	The channel has interference above the interference threshold
Blue	Available	The channel has an interference level below the interference threshold and is considered by the Spectrum Management algorithm suitable for hosting the Point-to-Point link
Grey	Barred	The system administrator has barred this channel from use. Because the low signal levels encountered when a unit is powered up in a laboratory environment prior to installation (which makes the grey of the channel bar difficult to see). An additional red 'lock' symbol is used to indicate that a channel is barred.
Red	Radar Detected	Impulsive Radar Interference has been detected on this channel and the channel is unavailable for 30 minutes. At the end of the 30 minute period a Channel Availability Check is required to demonstrate no radar signals remain on this channel before it can be used for the radio link.

Region Bar	Region Bar	This channel has been barred from use by the local region regulator

7.10 Remote Management

The Remote Management page (Figure 79) allows the system administrator to configure the remote management of the PTP 500 Series Bridge.

Figure 79 - Remote Management



7.10.1 Control Access to HTTP Interface

The attribute **HTTP Access Enabled** allows a user to stop any access to a unit via the web interface. The default value for this control is set to “yes”, which means that the unit can be accessed using the web interface. If the option “No” is selected, then a warning is displayed as shown in Figure 80.

7.10.2 Control Access to Telnet Interface

The attribute **HTTP Telnet Enabled** allows a user to stop any access to a unit via the telnet interface. The default value for this control is set to “yes”, which means that the unit can be accessed using the telnet interface.

NOTE

If HTTP, Telnet and SNMP interfaces have been disabled, then the user needs to use the Recovery image to reset IP & Ethernet Configuration back to factory defaults to re-enable the HTTP-Telnet interfaces. SNMP can also be used to re-enable the other interfaces if SNMP is enabled.

7.10.3 SNMP (Simple Network Management Protocol)

The industry standard remote management technique is SNMP (Simple Network Management Protocol). The PTP 500 Series Bridge supports version 1 and version 2c of the SNMP protocol.

7.10.4 Supported Management Information Bases (MIBS)

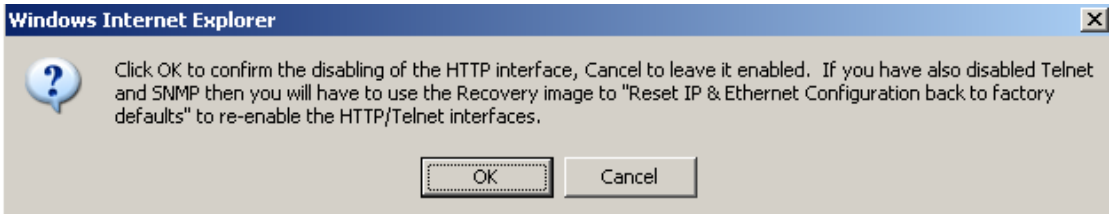
The PTP 500 Series Bridge SNMP stack currently supports the following MIBs:

- MIB-II, RFC-1213, The PTP 500 Series Bridge supports the ‘System Group’ and ‘Interfaces Group’.
- Bridge MIB, RFC-1493, The PTP 500 Series Bridge supports the ‘dot1dBase Group’ and the ‘dot1dBasePortTable Group’.
- PTP 500 Series Bridge proprietary MIB
- RFC-2233 (High capacity counter) MIB
- WiMAX MIB

SNMP TRAPs supported:

- Cold Start
- Link Up
- Link Down
- DFS Channel Change
- DFS Impulsive Interference

Figure 80 – Warning when disabling HTTP interface

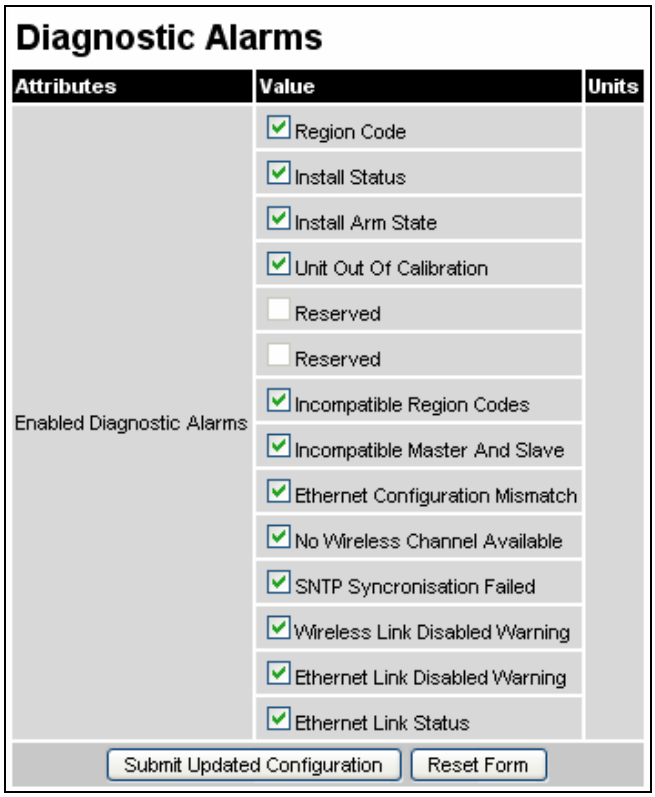


7.10.5 Diagnostics Alarms

A number of diagnostics alarms have been added to allow SNMP agents to receive traps and emails if required. Refer to Section 0 “

Home Page Alarm Display” for a description of all these alarms. Checking the control “Enabled Diagnostic Alarms” in SNMP and/or SNTP selects all the alarms shown in Figure 81. Users can access the sub-menu “Diagnostic Alarms” to modify the alarms selected.

Figure 81 - Remote Management - Diagnostic Alarms



For a copy of the Motorola proprietary version 1 and version 2 MIB RFCs please consult the installation CD

7.10.6 SNMP Configuration

The following SNMP configuration fields are displayed:

SNMP State

The SNMP state attribute controls the creation of the SNMP features. Changing the SNMP state attribute requires a mandatory reboot of the unit. Only when the SNMP state is enabled at system start-up will the SNMP processor task be created.

SNMP Enabled Traps

The SNMP Enabled Traps attribute controls which SNMP Traps the unit will send.

SNMP Community String

The SNMP community string acts like a password between the networks SNMP management entity and the distributed SNMP clients (PTP 500 Series bridge). Only if the community string is configured correctly on all SNMP entities can the flow of management information take place. By convention the default value is set to 'public'. When the community string is changed the system requires a mandatory reboot before the new string or phrase is adopted.

SNMP Port Number

Is the port the SNMP management agent is listening to for commands from an SNMP manager. The default value for this port number is 161.

SNMP Trap IP Address

Is the address of either the network SNMP manager or Trap receiver. When asynchronous events (traps in SNMP terminology) are generated, the client unicasts these to this IP Address. When the address is changed the system requires a mandatory reboot before the setting is adopted

SNMP Trap Version

The SNMP protocol version to use for SNMP traps. Note that a system reboot is required to activate changes to this attribute.

SNMP Trap Port Number

The SNMP Trap Port Number is the port number of either the networked SNMP manager or Trap receiver. By convention the default value for the port number is 162. When the port number is changed the system requires a mandatory reboot before the setting is adopted.

WiMAX Control

Enables and Disables the WiMAX (802.16) MIB. This control is only displayed when 'Fixed Frequency' is selected during installation.

7.10.7 SMTP (Simple Mail Transport Protocol)

The SMTP client is an alternative method for the PTP 500 Series bridge to alert a system administrator when there are or have been system errors:

SMTP Email Alert

This attribute controls the activation of the SMTP client.

SMTP Enabled Messages

The SMTP Enabled Messages attribute controls which email alerts the unit will send.

SMTP IP Address

The IP address of the networked SMTP server.

SMTP Port Number

The SMTP Port Number is the port number used by the networked SMTP server. By convention the default value for the port number is 25.

SMTP Source Email Address

The email address used by the PTP 500 Series to log into the SMTP server. This must be a valid email address that will be accepted by your SMTP Server.

SMTP Destination Email Address

The email address to which the PTP 500 Series bridge will send the alert messages.

7.10.8 SNTP (Simple Network Time Protocol)

The SNTP client allows the PTP 500 Series to obtain accurate date and time updates from a networked timeserver. The system time is used for SNMP and event logging.

SNTP State

When enabled, the Remote Management web page permits the following attributes to be set:

SNTP IP Address

The IP address of the networked SNTP server.

SNTP Port Number

The port number of the networked SNTP server. By convention the default value for the port number is 123.

SNTP Poll Interval

The period at which the SNTP client polls the server for time correction updates. Default 1 hour. If for any reason an SNTP poll fails, the client will automatically perform 3 retries before waiting for the user defined poll period.

Time Zone

The time zone is a fixed offset from GMT that is added to the SNTP time to allow the expression of time in all geographic time zones.

Daylight Saving

Allows a fixed offset of one hour to be added to the SNTP time in order to reflect the local daylight saving time.

7.10.9 Setting the clock

The PTP 500 Series bridge has a system clock which can be used to supply accurate date and time information in the absence of a SNTP server. The system clock is battery backed and will continue to operate for several days if the PTP 500 Series bridge has been switched off.

SNTP State

If the SNTP State is set to “Disabled”, see Figure 79, then the Remote Management web page allows the following attributes to be set:

Set Time

Shows the current time in 24 hour mode. The three editable fields display hours minutes and seconds.

Set Date

Displays the current date. The year, month and day can be set using the drop-down selection boxes.

Time Zone

See Section.7.10.9 “Setting the clock”.

Daylight Saving

See Section 7.10.9 “Setting the clock”

7.11 Diagnostics Plotter

For the PTP 500 Series, the storage of link performance histograms is set to 31 days worth of data. To optimize RAM (volatile memory) usage of a cascading histogram approach has been adopted. The data is stored for one hour at a resolution of one second. The histograms use a cascading approach to daisy chain multiple histograms together. When the first histogram fills up the overflow from the first is used as an input to the next histogram in line. To optimize memory utilization, a statistical analysis is performed on the overflow to reduce the amount of data to be stored. The cascading histograms are defined as:

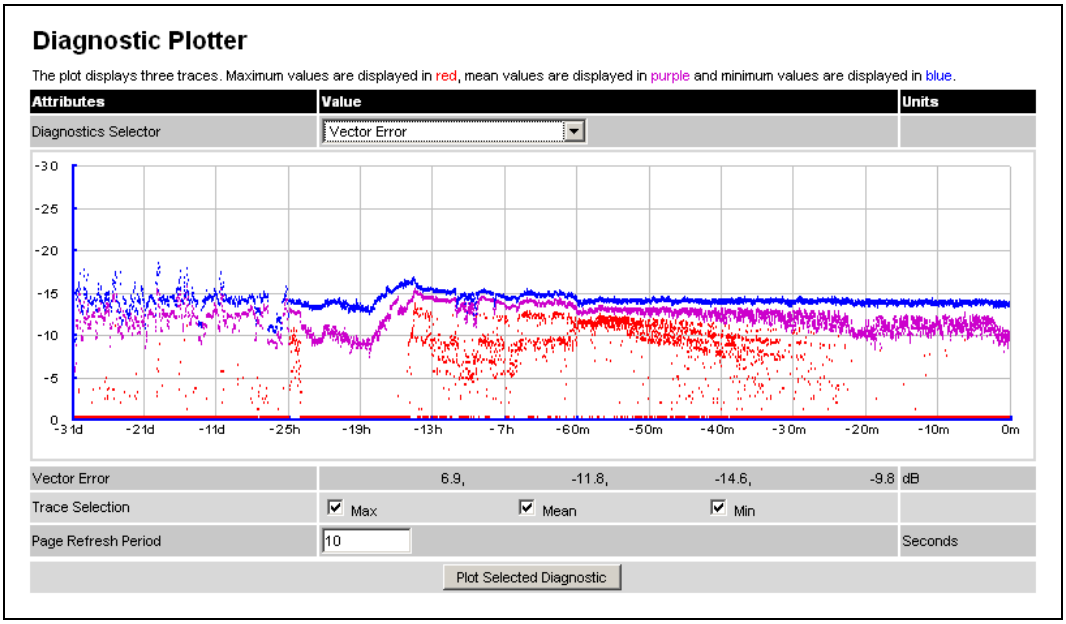
- Histogram 1: 1 hour at a resolution of 1 second
- Histogram 2: 24 hours at a resolution of 1 minute
- Histogram 3: 30 Days at a resolution of 1 hour

For example, when histogram 1 fills up and starts to overflow the first minute of overflow is analyzed and the maximum, minimum and mean over that minute are computed and inserted into histogram 2. When histogram 2 fills up and starts to overflow the first hour of overflow is analyzed and the maximum, minimum and mean over that hour is computed and inserted into histogram 3. When histogram 3 starts to overflow, the overflow data is simply discarded.

7.11.1 Diagnostic Plotter Page

New for the PTP 500 Series is the system administration diagnostic plotter facility see Figure 82.

Figure 82 - Diagnostic Plotter



The diagnostic plotter allows the system administrator to view the cascading histogram data in an easily accessible graphical form. The plot always displays three traces, maximum, minimum and mean by default. The diagnostic selector allows the user to select the various categories of histogram.

The histograms that are available are:

- Vector Error
- Rx Power
- Tx Power
- Signal Strength Ratio
- Link Loss
- Rx Data Rate
- Tx Data Rate
- Aggregate Data Rate

The diagnostic plotter uses a novel time representation in the x-axis which compresses the timeline of the plot without sacrificing resolution.

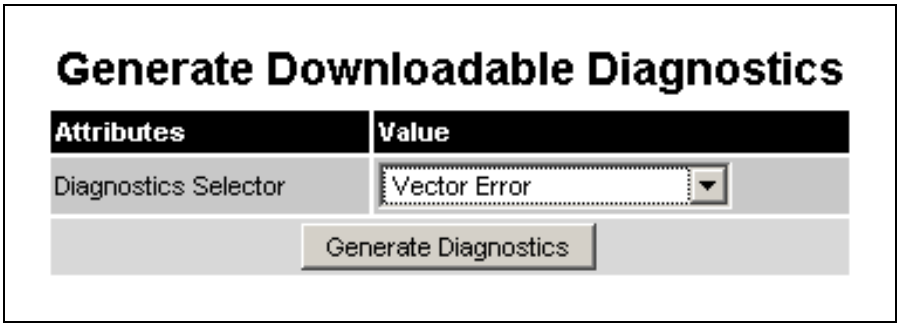
The trace selection allows the user to control which traces are plotted.

As with other management pages the page refresh period can be used to interactively monitor the wireless link.

7.11.2 CSV Download

The diagnostics Download page allows the system administrator to download snapshots of system diagnostics.

Figure 83 - CSV Download



The following diagnostics are available:

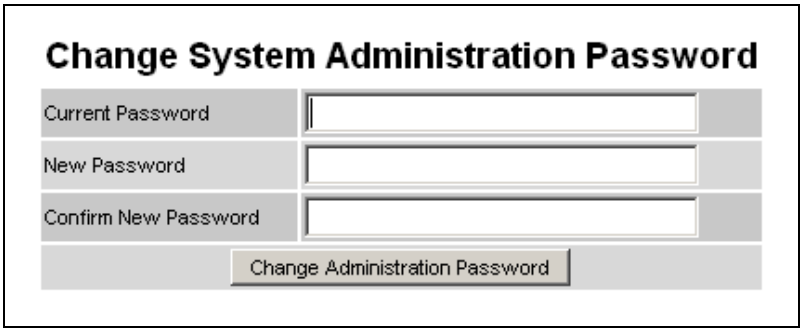
- Vector Error
- Rx Power
- Tx Power
- Signal Strength Ratio V/H
- Link Loss
- Rx Data Rate
- Tx Data Rate
- Aggregate Data Rate
- Receive SNR
- Rx Gain

All diagnostics are extracted from the associated status and statistics web page histograms. They are translated in a CSV file containing at most 5784 entries. These 5784 entries comprise 3600 entries for the first hour, 1440 entries for the next 24 hours and 744 entries for the next 31 days.

7.12 Change Password

This page (Figure 84) is used to change the password for the system administration (The factory default is blank).

Figure 84 - Password Change

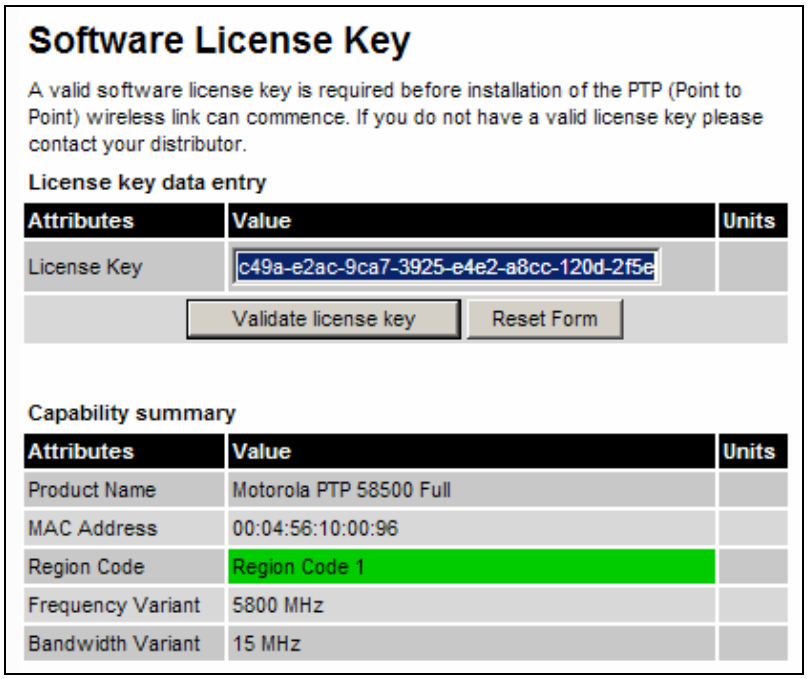


The password may contain any combination of characters, up to 31 characters in length.

7.13 License Key

The License Key data entry page allows the system administrator to update the PTP 500 Series bridge license key. Figure 85 shows a sample license key data entry page.

Figure 85 - Software License Key Data Entry



The user must enter the license key and click the 'Validate License Key' button to check that the key is valid and program it to non-volatile memory.

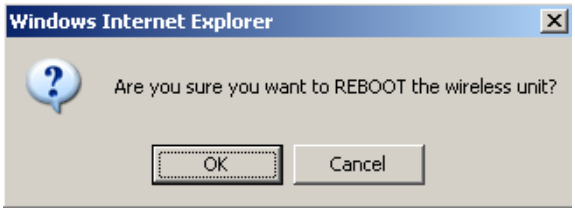
If a valid license key is detected then the user will be presented by a system reboot screen.

Figure 86 - License Key reboot Screen



The user will then be asked to confirm the reboot (Figure 87).

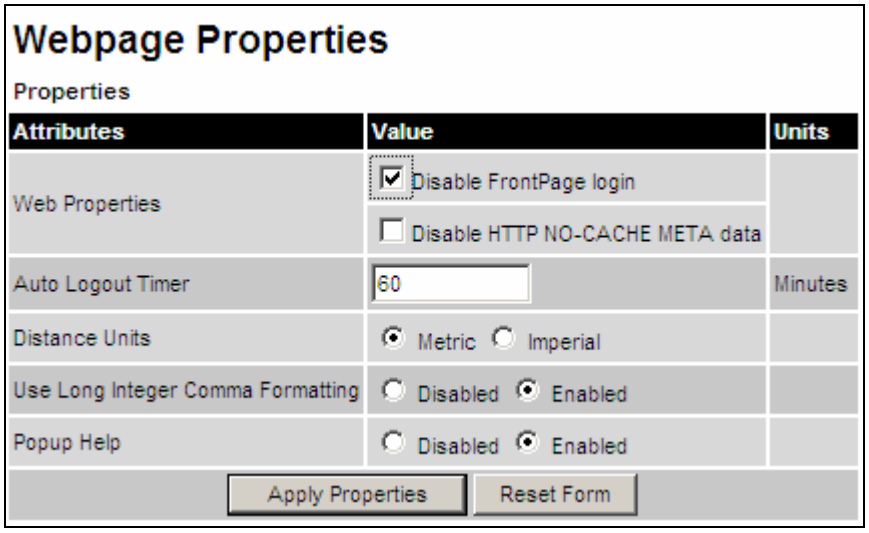
Figure 87 - Reboot Confirmation Pop Up



7.14 Properties

The web page properties screen allows the user to configure the web page interface (Figure 88).

Figure 88 – Properties



The Properties page contains the following fields:

WEB Properties: Disable Front Page Login

Allows access to homepage and status page web pages without forcing a login as the system administrator.

WEB Properties: Disable HTTP NO-CACHE META data

Removes the HTTP NO-CACHE META clause from all dynamically created web pages.

Auto Logout Timer

Configures the time, in minutes, when the system administrator is automatically logged out if no web page activity is detected.

Distance Units

Swaps the default metric display of distance in to imperial units, for example km to Miles.

Use Long Integer Comma Formatting

Changes the format of long integers from 1000000 to 1,000,000.

popup Help

Click on the attribute to get a help text box which gives a brief description of the attribute.

7.15 Reboot

The reboot page allows the system administrator to perform commanded reboots of the wireless unit. The reboot page also allows the system administrator to view a list of past reboot reasons. The “Previous Reasons For Reset/Reboot” field has been implemented as a drop down selection box, where the latest reason for reboot is located at the top of the list.

If the SNTP service from the remote management section above is active, or the system time has been set, then the command reboot reason will be accompanied by the date and time at which the reboot occurred.

Figure 89 - System Reboot

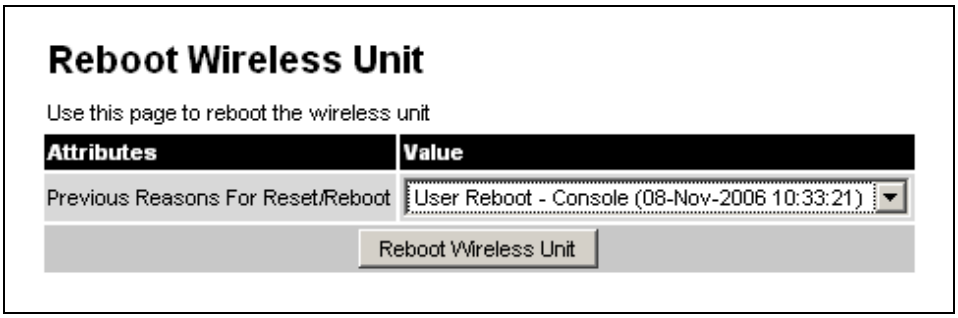
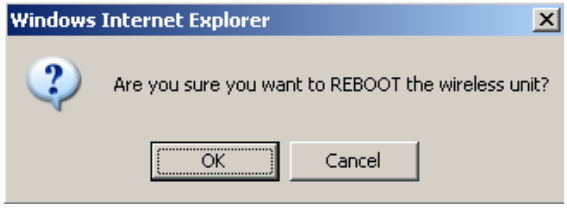


Figure 90 - Reboot Confirmation Pop Up



8 Recovery Mode

This section provides instructions to allow users to recover a PTP 500 link.

The Motorola PTP 500 point-to-point wireless Ethernet bridges have a special mode of operation that allows the user to recover a unit from configuration errors or software image corruption.

The following topics are described in this section:

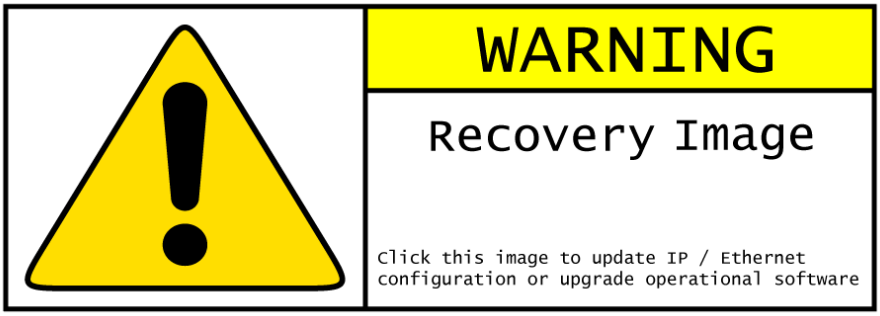
- 8.1 Entering Recovery Mode
- 8.2 Upgrade Software Image
- 8.3 Reset IP & Ethernet Configuration
- 8.4 Erase Configuration
- 8.6 Reboot

8.1 Entering Recovery Mode

Recovery mode is entered by depressing the Recovery Switch located on the underside of the PIDU Plus while applying mains power, as shown in Section 2.7 “PIDU Plus PTP 300/500/600 Series” The Recovery Switch should be held in the depressed state for between 10 and 20 seconds after the application of mains power. The Ethernet LED will flash with 10 double flashes at power up (following the release of the Recovery switch).

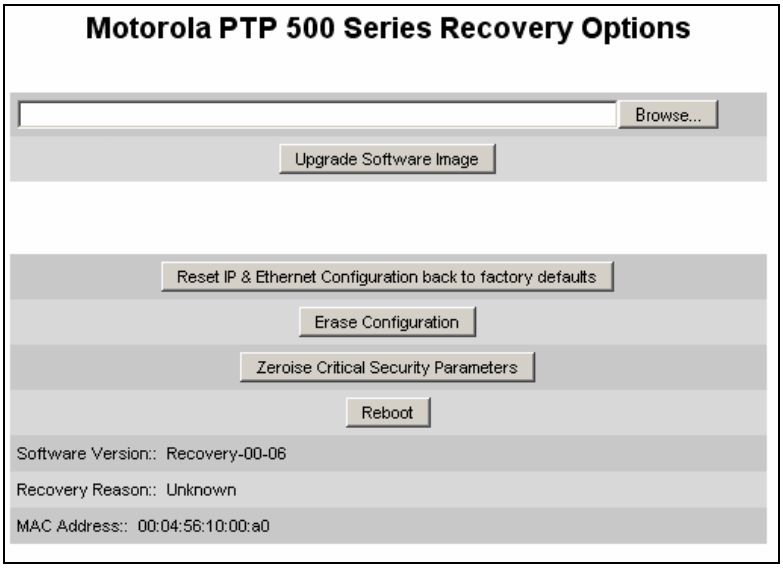
When in recovery mode the user will be able to access the unit via the Ethernet interface. The Ethernet interface will have its IP address set to 169.254.1.1 (or 10.10.10.10 see section 6.5.10 “Powering Up”). On connection to a unit in recovery mode the following screen is displayed (Figure 91):

Figure 91 - Recovery Mode Warning Page



Clicking on the warning page image will take the user on to the Recovery Option Page (Figure 92).

Figure 92 - Recovery Options Page



The recovery options available are:

Upgrade Software Image

This allows the user to reload a software image. This may be the original image if software corruption is suspected or a step back to an old image if an incorrect image has just been loaded.

Reset IP & Ethernet Configuration back to factory defaults

This allows the user to reset the unit back to the factory defaults:

IP Address	169.254.1.1 (or 10.10.10.10)
Netmask	255.255.0.0
Gateway	169.254.1.0
Ethernet Interface	Auto-negotiate, Auto-MDI/MDIX

Erase Configuration

This allows the user to erase the unit's entire configuration. Executing this option will also erase factory settings such as target MAC address, range setting, license key, etc.

Zeroise Critical Security Parameters

This allows the user to erase the security parameters such as AES parameters.

Reboot

This allows the user to reboot the unit. This option must be executed after resetting the IP & Ethernet configuration or erasing the configuration detailed above.

Software Version

This is the software version of the recovery operating system permanently installed during manufacture.

Recovery Reason

Indicates the reason the unit is operating in Recovery mode. Possible reasons are “Recovery button active” or “Invalid or corrupt image”

MAC Address

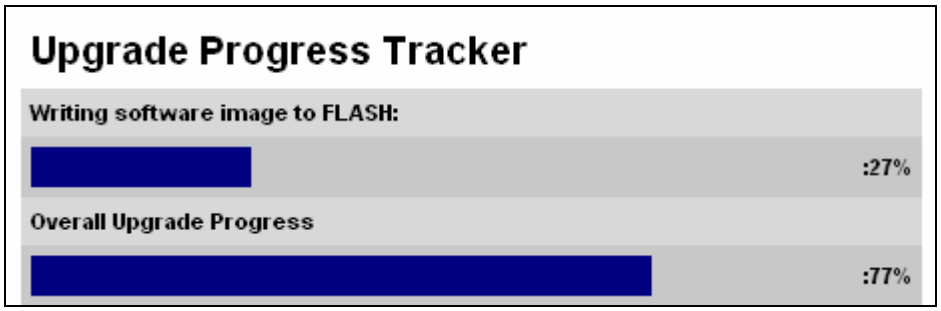
The MAC address shown here is the MAC address of the unit programmed during manufacture.

8.2 Upgrade Software Image

The first step (Figure 92) is to use the ‘Browse’ button to locate the software image to be downloaded. Once located the user should press the “Upgrade Software Image” button to start the software download process.

During software download, progress is indicated by a pair of progress bars (Figure 93).

Figure 93 - Software Download Progress Indicator Page



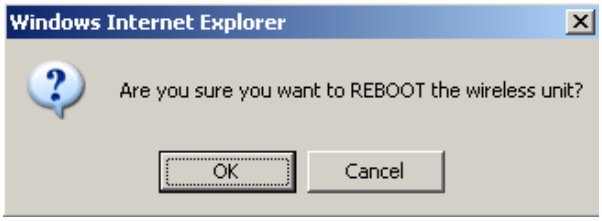
When the download is complete a page is displayed indicating the status of the software download (Figure 94).

Figure 94 - Software Download Complete Page



After carefully checking that correct image has been downloaded the user should reboot the unit by pressing the “Reboot Wireless Unit” button. The user will then be presented with a pop up box asking them to confirm the action (Figure 95).

Figure 95 - Reboot Confirmation Pop Up

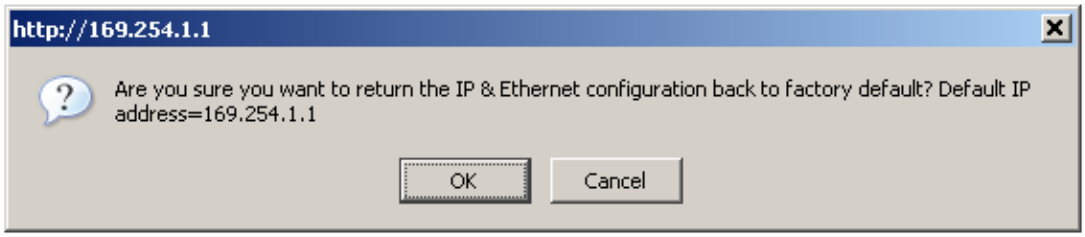


The unit will now reboot. Providing the unit configuration is still intact the unit should restart in normal operational mode and the link should recover. Should the unit or link fail to recover the user should refer to Section 9 “ (Fault Finding”.

8.3 Reset IP & Ethernet Configuration

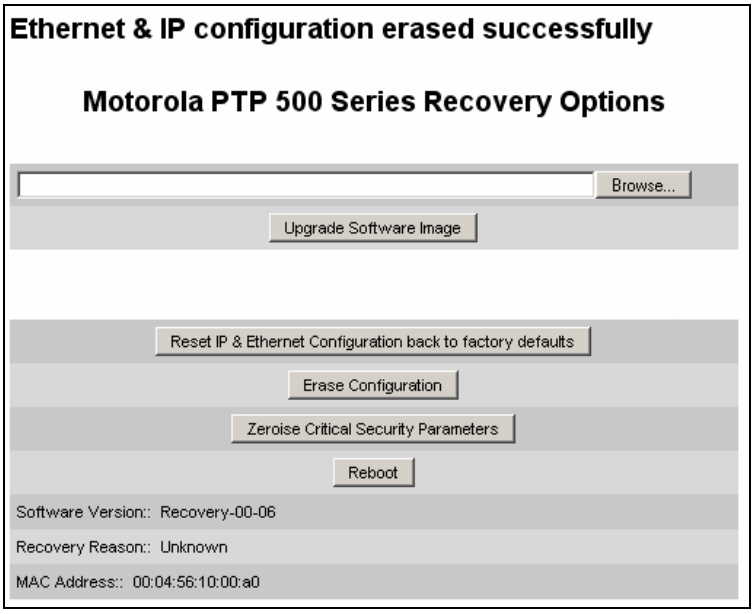
To reset IP & Ethernet configuration back to factory defaults the user should press the “Reset IP & Ethernet Configuration back to factory defaults” button on the “Recovery Options” page (Figure 92). The user will now be presented with a pop up box asking them to confirm the action (Figure 96).

Figure 96 - Confirm Reset to Factory Default Pop Up



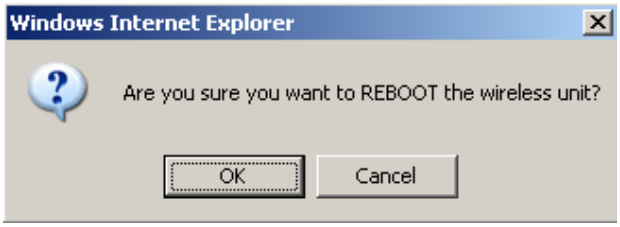
On confirmation the following page will be displayed (Figure 97). The user should now reboot the unit by pressing the “Reboot” button.

Figure 97 - IP and Ethernet Erased Successfully page



The user will now be presented with a pop up box asking them to confirm the action (Figure 98).

Figure 98 - Reboot Confirmation Pop Up

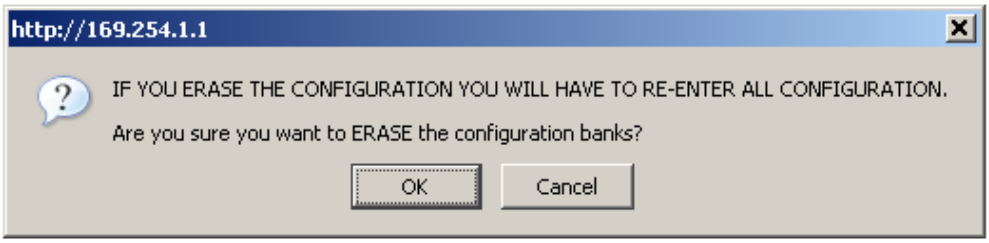


The unit will now reboot. The unit should now start up in normal mode but with the IP address set to 169.254.1.1 and the Ethernet interface set to auto-negotiate and auto-MDI/MDIX. Should the unit fail to start up the user should refer to Section 9 " (Fault Finding".

8.4 Erase Configuration

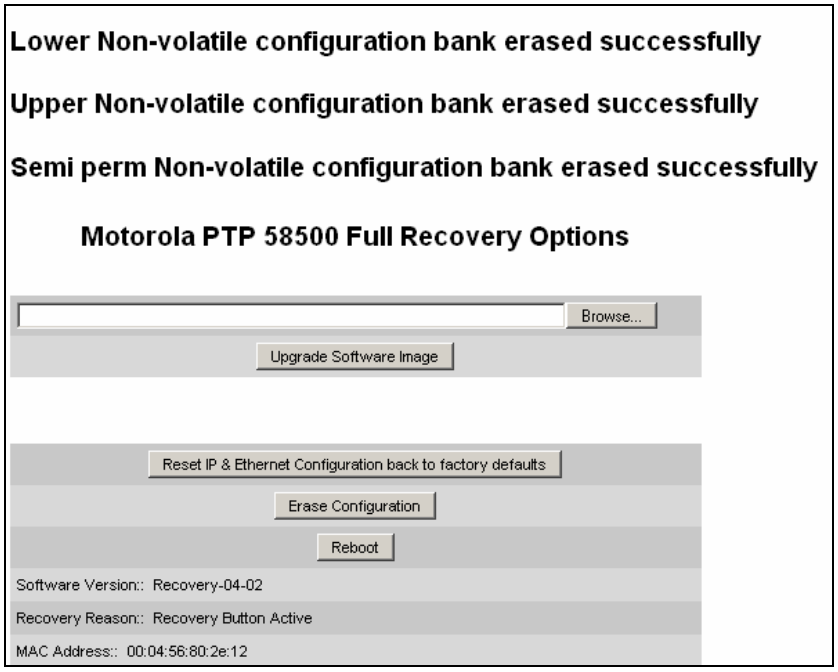
To erase the unit's configuration the user should press the "Erase Configuration" button on the "Recovery Options" page (Figure 92). The user will now be presented with a pop up box asking them to confirm the action (Figure 99).

Figure 99 - Confirm Erase Configuration Pop Up



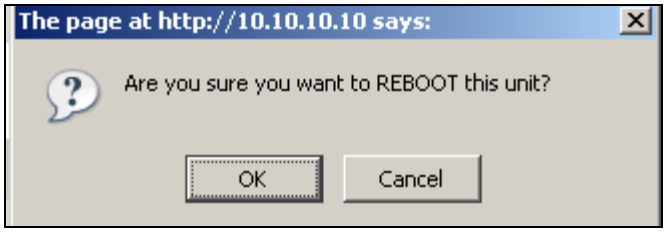
On confirmation the following page will be displayed (Figure 100). The user should now reboot the unit by pressing the “Reboot” button.

Figure 100 - Erase Configuration Successful Page



The user will now be presented with a pop up box asking them to confirm the action (Figure 101)

Figure 101 – Erase Configuration - Reboot Confirmation Pop Up

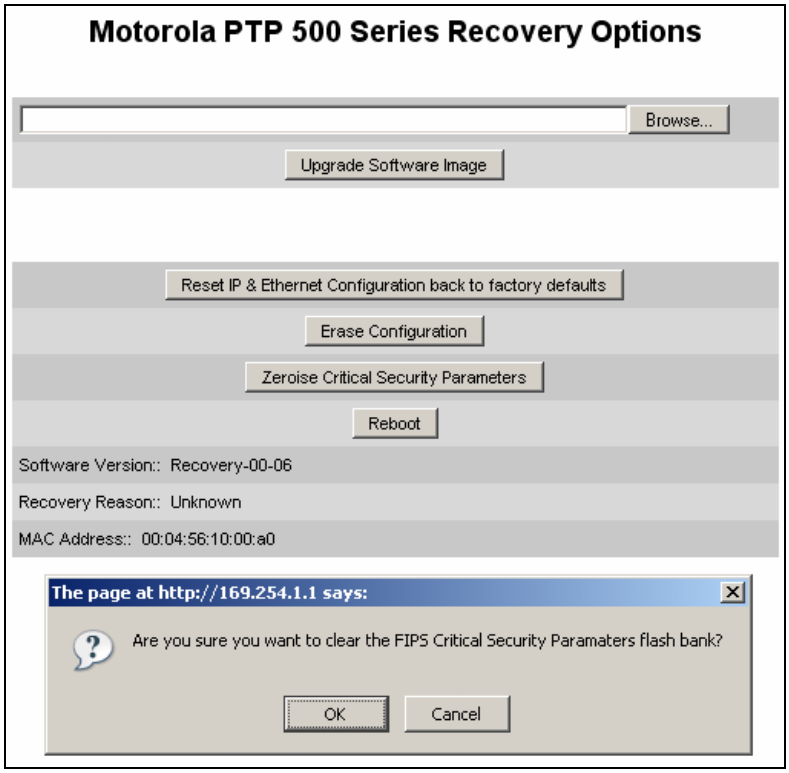


The unit will now reboot. The unit should now start up in normal mode but with all configuration erased. Should the unit fail to start up the user should refer to Section 9 “ (Fault Finding”.

8.5 Erase Security Parameters

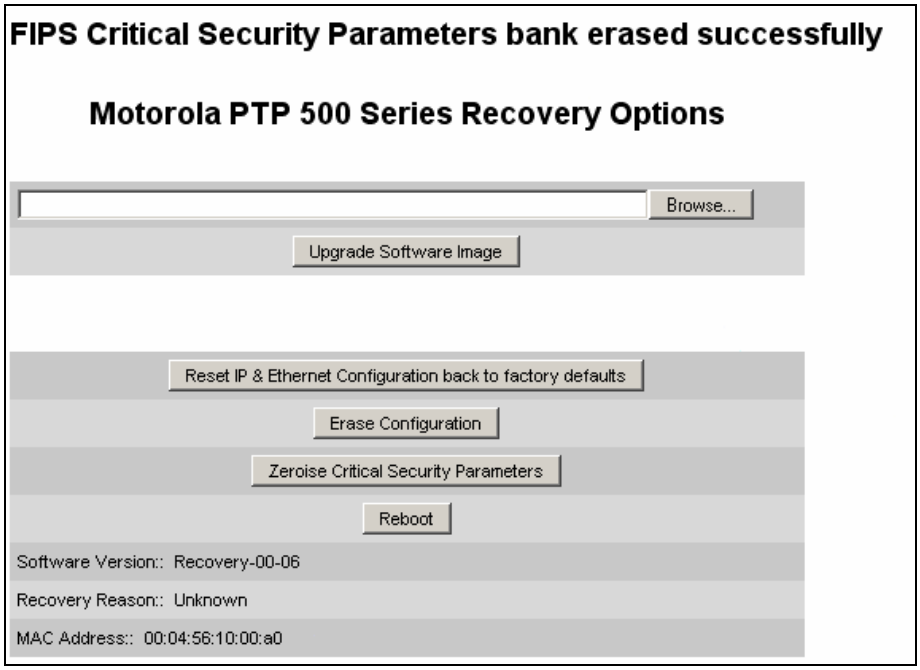
To erase the unit's security parameters, the user should press the ``Zeroise Critical Security Parameters'' button on the ``Recovery Options'' page Figure 92. The user will now be presented with a pop up box asking them to confirm the action (Figure 102).

Figure 102 - Confirm Zeroise Security Parameters Pop Up



On confirmation the following page will be displayed (Figure 103).

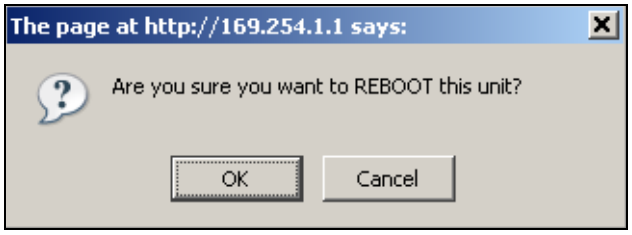
Figure 103 - Zeroise Security Parameters Successful Page



8.6 Reboot

This option can be used to reboot the unit. The user will now be presented with a pop up box asking them to confirm the action (Figure 104).

Figure 104 – Recovery - Reboot Confirmation Pop Up



The unit will now reboot. The unit should now start up in normal operational mode. Should the unit fail to start up the user should refer to Section 9 “Troubleshooting (Fault Finding)”.

9 Troubleshooting (Fault Finding)

This section provides instructions for troubleshooting (fault finding) a PTP 500 link.

Perform the following procedures either on a newly installed link, or on an operational link if communication is lost:

1. Test the hardware at one end of the link, as described in Section 9.1 “Test Link End Hardware”.

2. Test the hardware at the other end of the link, as described in Section 9.1 “Test Link End Hardware”.

3. Test the radio link, as described in Section 9.2 ”Test Radio Link”.

4. If an installation has been struck by lightning, see Section 9.3 “Lightning Strike”.

9.1 Test Link End Hardware

When the link end hardware (PIDU Plus, LPU, ODU and cabling) has been installed, start it and test it by following this procedure:

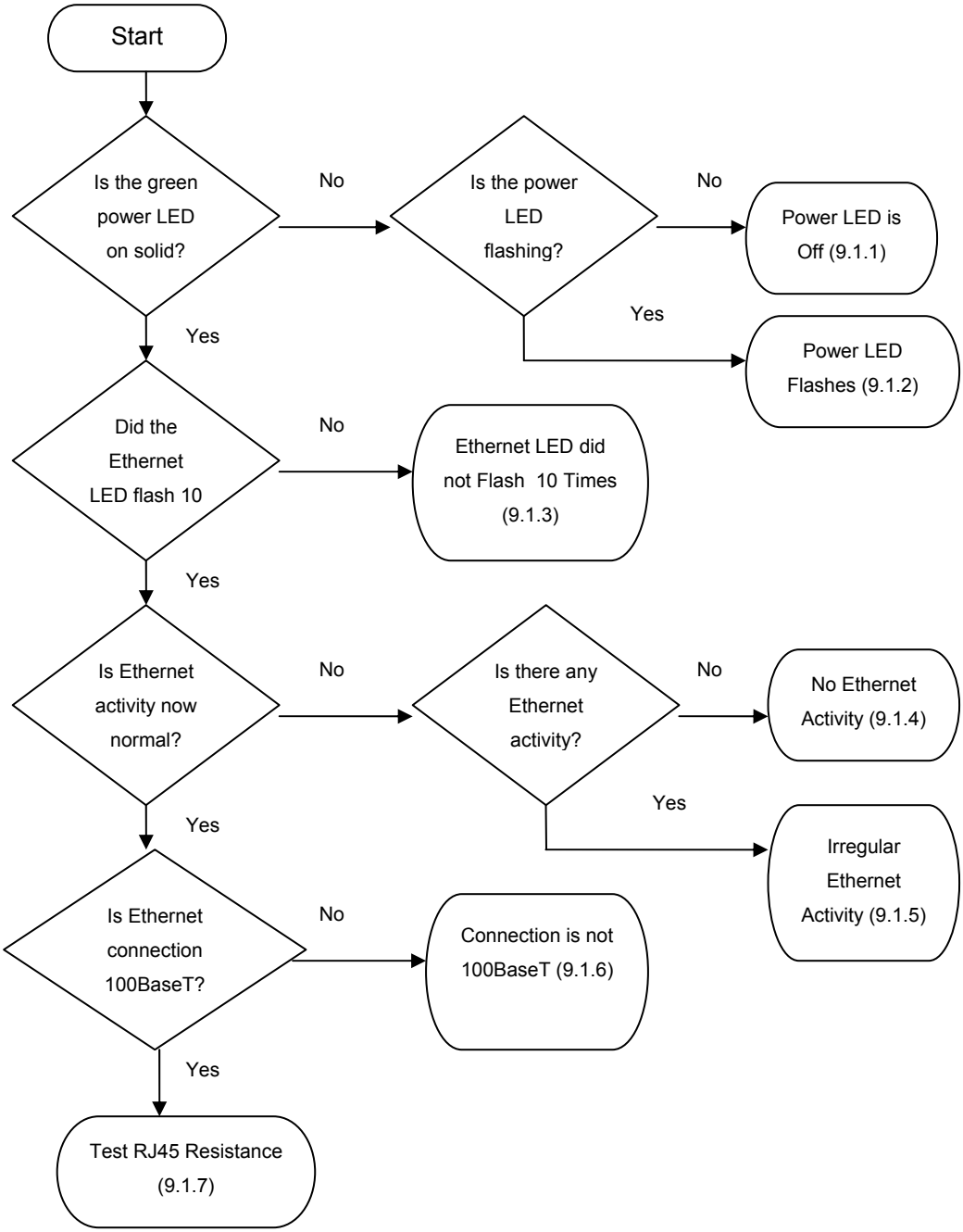
1. Connect the RJ45 from the ODU (or LPU if fitted) to the PIDU Plus and apply mains or battery power to the PIDU Plus. The green Power LED should illuminate continuously.

2. After 45 seconds, the yellow Ethernet LED should be observed starting with 10 slow flashes.

3. Connect the RJ45 from the LAN port of the PIDU Plus to the network. The yellow Ethernet LED should blink randomly as traffic passes through.

4. If the Power and Ethernet LEDs do not illuminate correctly, test the link end as described in the flowchart (Figure 105) and detailed test procedures (Sections 9.1.1 to 9.1.7).

Figure 105 – Link End Hardware Test Flowchart



9.1.1 Power LED is Off

If the green Power LED does not light up at all, perform the following tests:

1. Remove the power lead from the PIDU Plus and test that the power source (mains or 56 V battery) is working.

2. If the main or battery power supply is working, open the flap on the left hand side of the PIDU Plus and remove the RJ45 ODU cable from the PIDU Plus.

3. If the Power LED does not illuminate when the RJ45 ODU cable is removed:
    i. Measure the voltage across the +55 V and 0 V pads inside the PIDU Plus flap. An incorrect reading indicates that the PIDU Plus is short-circuited.
    ii. Measure the impedance across the Power connector. An incorrect reading indicates that the PIDU Plus is short-circuited.
    iii. If both of the above tests are successful, it is likely that the PIDU Plus Power LED is faulty.

4. If the Power LED does illuminate when the RJ45 ODU cable is removed:
    i. Remove the jumper (J905) found inside the PIDU Plus flap.
    ii. Measure the current with an ammeter placed across the two jumper pins. It should be 10 mA with the ODU disconnected. An incorrect ammeter reading indicates that the PIDU Plus is faulty.

5. If all tests so far have succeeded:
    i. Reconnect the RJ45 ODU cable to the PIDU Plus.
    ii. Measure the current with an ammeter placed across the two jumper pins. It should be in the range 300 mA to 1 A with the ODU connected.
    iii. If the ammeter reading is too high, the ODU may be drawing too much power, or the ODU may be short-circuited.
    iv. If the ammeter reading is too low, the PIDU Plus may be supplying too little power.

9.1.2 Power LED is Flashing

If the green Power LED flashes, perform the following tests on the RJ45 cable that connects the PIDU Plus to the LPU or ODU:

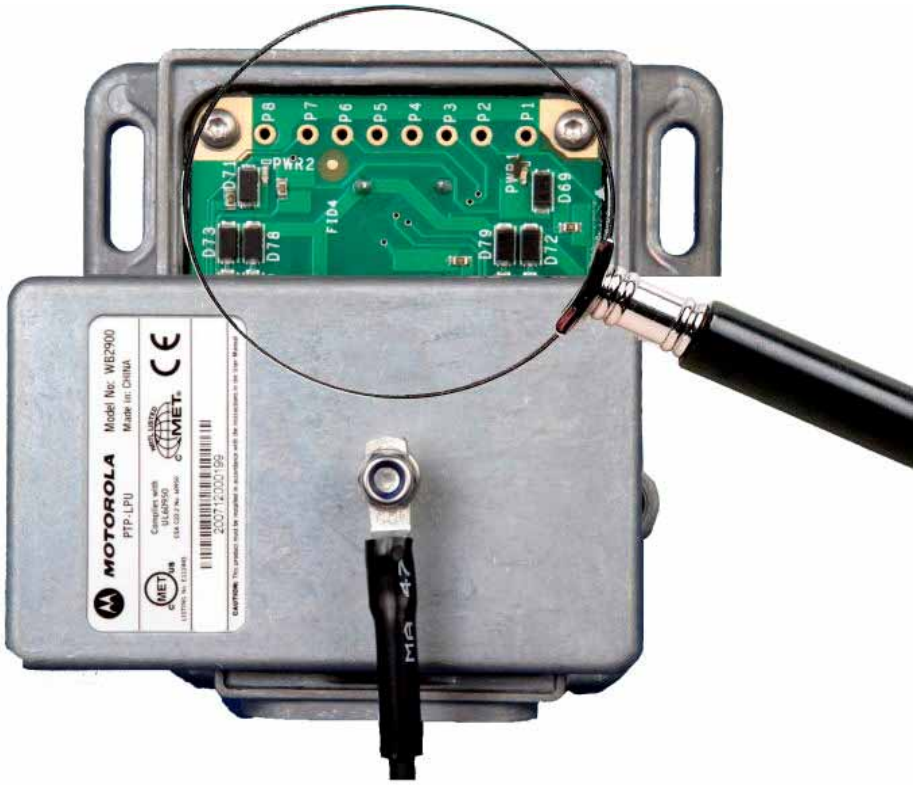
1. Check that pins 4&5 and 7&8 are not crossed with pins 1&2 and 3&6.
2. Check that the resistance between pins 1&8 is greater than 100K ohms.
3. If either test fails, replace or repair the RJ45 cable.

9.1.3 Ethernet LED did not Flash 10 Times

When the PIDU Plus is connected to the power supply and the green Power LED illuminates, there should be a 45 second delay, following which the yellow Ethernet LED should flash 10 times. If the Ethernet LED did not flash 10 times, perform the following tests on the RJ45 cable that connects the PIDU Plus to the LPU or ODU:

1. Check that the wiring to pins 4&5 and 7&8 is correct. For example, the wiring to pins 4 and 7 may be crossed.
2. If an LPU is installed, it can be used to check that power is available on the cable to the ODU. The connections can be accessed by rotating the LPU lid as shown in Figure 106 The Lid nut only needs to be slacken, do not remove. Test point P1 on the LPU PCB corresponds to pin 1 on the RJ45 etc. An indication of power on the Ethernet cable is also provided inside the LPU: the LED PWR1 should illuminate but LED PWR2 should not.

Figure 106 - PTP LPU Test Points



If either test fails, replace or repair the RJ45 cable.

9.1.4 No Ethernet Activity

If the Ethernet LED did flash 10 times but then went off, check that the RJ45 connection from the LAN port of the PIDU Plus to the PC is working. If the PC connection is working, perform the following test on the RJ45 cable that connects the PIDU Plus to the LPU or ODU:

1. Check that the wiring to pins 1&2 and 4&6 is correct. For example, the wiring to pins 1 and 3 may be crossed.

2. If this test fails, replace or repair the RJ45 cable.

9.1.5 Irregular Ethernet Activity

The yellow Ethernet LED should blink randomly as normal traffic passes through. If the Ethernet LED flashes irregularly, for example there is a short flash followed by a long flash, this indicates that the ODU has booted in recovery mode. The causes may be installation wiring or a corrupt ODU software load. For more information, see Section 8 “Recovery Mode”.

9.1.6 Connection is not 100BaseT

If the Ethernet connection to the network is only 10BaseT, when 100BaseT is expected, perform the following test on the RJ45 cable that connects the PIDU Plus to the LPU or ODU:

1. Check that the wiring to pins 4&5 and 7&8 is correct. For example, the wiring to pins 4 and 7 may be crossed.

2. If this test fails, replace or repair the RJ45 cable.

9.1.7 Test RJ45 Resistance

If the above procedures fail to diagnose the issue, there may be a fault in the wiring of the RJ45 cable that connects the ODU (or LPU) to the PIDU Plus. Unplug this cable from the PIDU Plus, then perform the following test procedure:

1. Check the cable resistance between pins 1&2, 3&6, 4&5 and 7&8 at the RJ45. Check against column 2 in Table 16. Resistances for each pair should be within 1 ohm of each other.

2. Check the cable resistance between pins 1&3 and 4&7 at the RJ45. Check against columns 3 and 4 respectively in Table 16.

3. Ensure that there is greater than 100K ohms between pin 1 and ODU ground for all cable lengths.

4. Ensure that there is greater than 100K ohms between pin 8 and ODU ground for all cable lengths.

5. Ensure that there is greater than 100K ohms between pin 1 and pin 8 for all cable lengths.

Table 16 - Resistance Table Referenced To The RJ45 at the PIDU Plus

Resistances should fall within + or -10% of the stated values.

CAT-5 Length (Meters)	Resistance between pins 1&2, 3&6 , 4&5 and pins 7&8 (ohms)	Resistance between pins 1&3 (ohms)	Resistance between pins 4&7 (ohms)
0	0.8	1.0	1.6
10	2.7	2.7	3.3
20	4.6	4.4	5.0
30	6.5	6.1	6.7
40	8.3	7.8	8.4
50	10.2	9.5	10.1
60	12.1	11.2	11.8
70	14.0	12.9	13.5
80	15.8	14.6	15.2
90	17.7	16.3	16.9
100	19.6	18.0	18.6
150	29.0	26.5	27.1
200	38.4	35.0	35.6
250	47.7	43.5	44.1
300	57.1	52.0	52.6

9.2 Test Radio Link

9.2.1 No Activity

If there is no communication over the radio link and the unit at the other end of the link can be managed on its local network, the following procedure should be adopted:

If there is no wireless activity then the configuration should be checked. It is essential that the following items are correct:

1. Check for Alarm conditions on Home page.
2. Check that the software at each end of the link is the same version.
3. Check that the Target Mac address has been correctly configured at each end of the link.
4. Check Range.
5. Check Tx Power.
6. Check License keys to ensure that both units are the same product variant.
7. Check Master/Slave status for each unit and ensure that one unit is Master and the other unit is slave.
8. Check that the link has not been further obscured or the ODU misaligned.
9. Check the DFS page at each end of the link and establish that there is a quiet wireless channel to use.

If there are no faults found in the configuration and there is absolutely no wireless signal, retry the installation procedure. If this does not work then the ODU may be faulty.

9.2.2 Some Activity

If there is some activity but the link is unreliable or does not achieve the data rates required then:

1. Check that the interference has not increased using the i-DFS measurements.
2. If a quieter channel is available check that it is not barred.
3. Check that the path loss is low enough for the communication rates required.
4. Check that the ODU has not become misaligned.

9.3 Lightning Strike

If a link end installation is struck by lightning, perform the following diagnostic procedure:

1. Perform the tests specified in Section 9.1 “Test Link End Hardware”. Ensure that the PIDU Plus is working and that the resistances are correct as specified in 9.1.7 “Test RJ45 Resistance”.
2. If the ODU is not working, power off the ODU and both LPUs and return them to Motorola.
3. If the ODU is working but there is suspicion of damage to the LPU, then take the LPUs down and take the covers off, inspect for damage, test the big diode for short circuit and test all other diodes for forward voltage.

10 Connectorized PTP 500 Series Bridge

This section details the changes and additional features relevant to the connectorized version of the PTP 500 Series products.

The following topics are described in this section:

- 10.1 Product Description
- 10.2 Software/Features
- 10.3 Deployment Considerations
- 10.4 Link Budget
- 10.5 Regulatory Issues with Connectorized Units
- 10.6 Antenna Choices
- 10.7 Installation
- 10.8 Additional Lightning Protection

10.1 Product Description

10.1.1 Hardware

The Connectorized PTP 500 Series Bridge is a variant designed to provide the system integrator and installer with the ability to provide extra capability to cope with very difficult radio links compared to the PTP 500 Series Integrated model. The variant allows the use of a variety of externally mounted antennas, either Flat Plate or Dish, which have higher gains than provided by the integrated antenna that is normally used.

Figure 107 – Connectorized PTP 500 Series Bridge Outdoor Unit



10.1.2 Antenna

The antenna choices for the Connectorized bridge are described in 10.6 “Antenna Choices”.

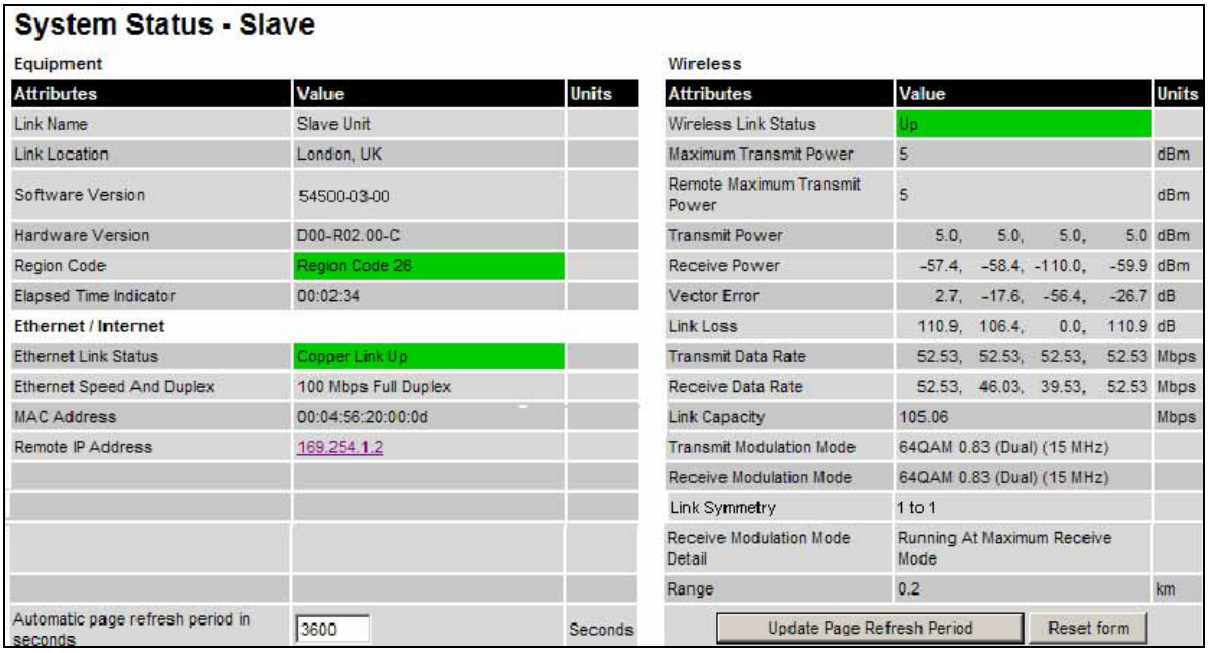
10.2 Software/Features

This section only describes the areas where functionality is modified for the connectorized variant. For details of the functionality that is common to the integrated and connectorized variants, see Section 7 “Web Page Reference”.

10.2.1 Status Page

The link loss calculation presented on the Status Page of the management interface has to be modified to allow for the increased antenna gains at each end of the link. The manufacturing process of the Connectorized PTP 500 Series Bridge configures the standard hardware of the unit for use with external antennas. The installer is prompted, as part of the installation process, to enter the gain of the external antenna(s) and cable losses at each end of the link. Peer-to-peer messaging is used to pass the effective antenna gain to each end of the link so that the link loss calculations can be correctly computed.

Figure 108 - Connectorized PTP 500 Series Bridge Status Page



System Status - Slave

Equipment

Attributes	Value	Units
Link Name	Slave Unit	
Link Location	London, UK	
Software Version	54500-03-00	
Hardware Version	D00-R02.00-C	
Region Code	Region Code 26	
Elapsed Time Indicator	00:02:34	
Ethernet / Internet		
Ethernet Link Status	Copper Link Up	
Ethernet Speed And Duplex	100 Mbps Full Duplex	
MAC Address	00:04:56:20:00:0d	
Remote IP Address	169.254.1.2	
Automatic page refresh period in seconds	3600	Seconds

Wireless

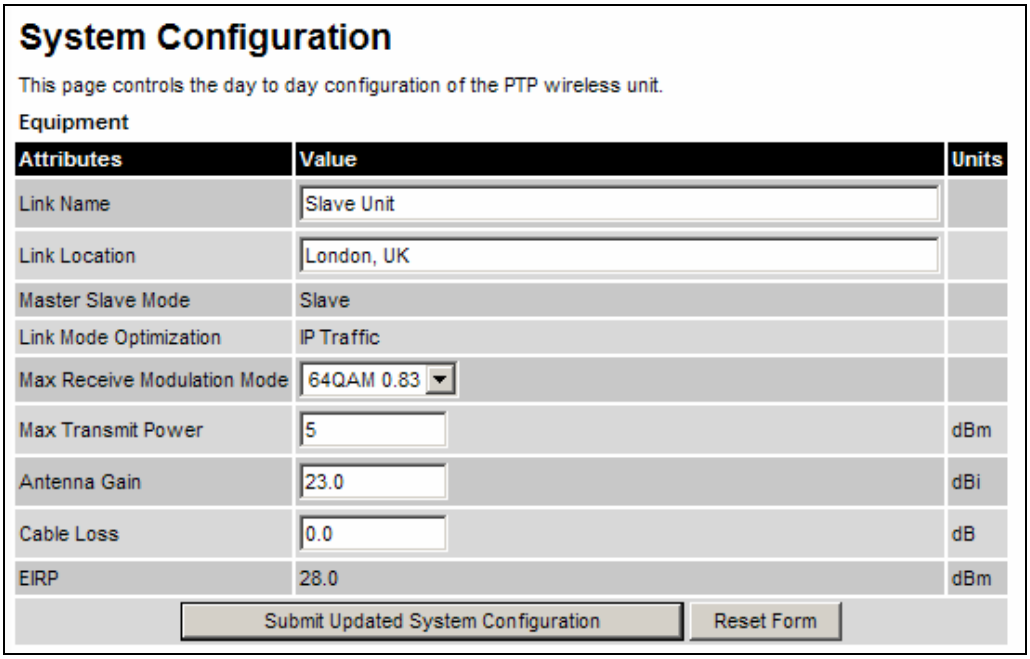
Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	5	dBm
Remote Maximum Transmit Power	5	dBm
Transmit Power	5.0, 5.0, 5.0, 5.0	dBm
Receive Power	-57.4, -58.4, -110.0, -59.9	dBm
Vector Error	2.7, -17.6, -56.4, -26.7	dB
Link Loss	110.9, 106.4, 0.0, 110.9	dB
Transmit Data Rate	52.53, 52.53, 52.53, 52.53	Mbps
Receive Data Rate	52.53, 46.03, 39.53, 52.53	Mbps
Link Capacity	105.06	Mbps
Transmit Modulation Mode	64QAM 0.83 (Dual) (15 MHz)	
Receive Modulation Mode	64QAM 0.83 (Dual) (15 MHz)	
Link Symmetry	1 to 1	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Range	0.2	km

Update Page Refresh Period | Reset form

10.2.2 Configuration Pages

The Configuration web page for the connectorized variant is shown in Figure 109. The parameters Antenna Gain, Cable Loss and EIRP are specific to the connectorized variant.

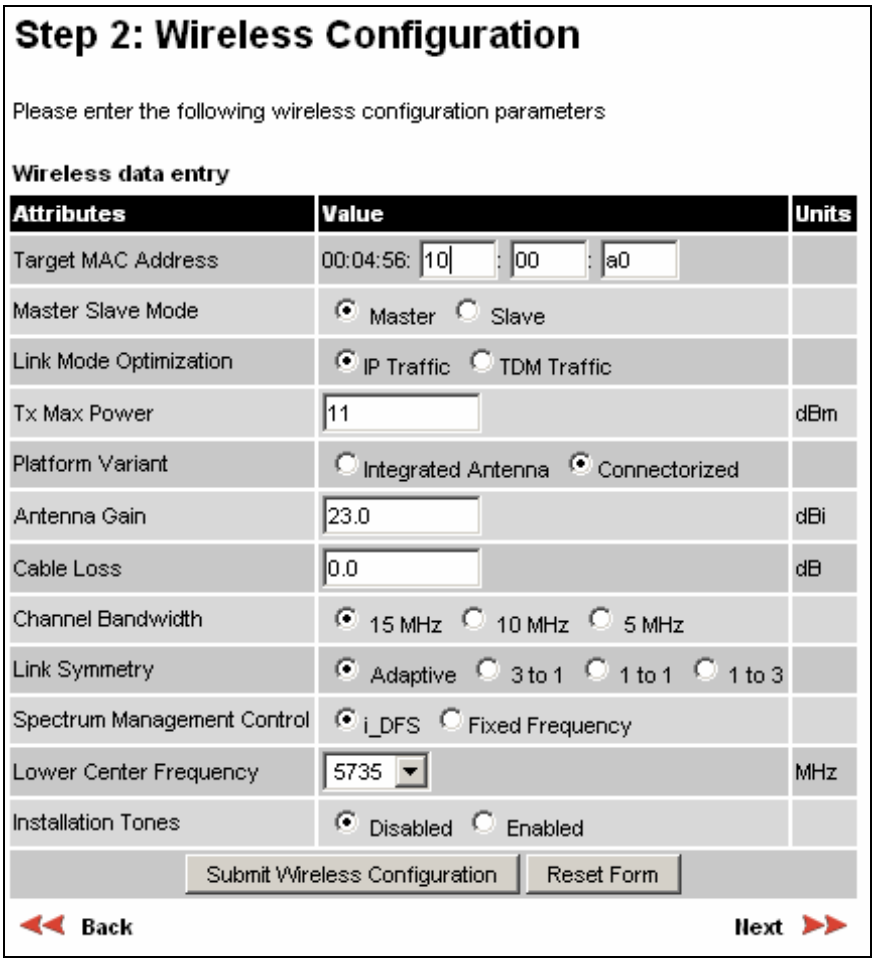
Figure 109 - Connectorized PTP 500 Series bridge 'System Configuration' Page



10.2.3 Installation Pages

The installer is prompted to enter the Antenna Gain and Cable Loss (Connectorized PTP 500 Series Bridge to antenna) at each end of the link. The Installation Pages for the connectorized version are shown as Figure 110 to Figure 112.

Figure 110 - Connectorized PTP 500 Series Bridge 'Installation Wizard' Page



Antenna Gain

Gain of the antenna you are connecting to the unit, see Section 10.6 "Antenna Choices".

Cable Loss

Loss in the cable between the ODU and the antenna.

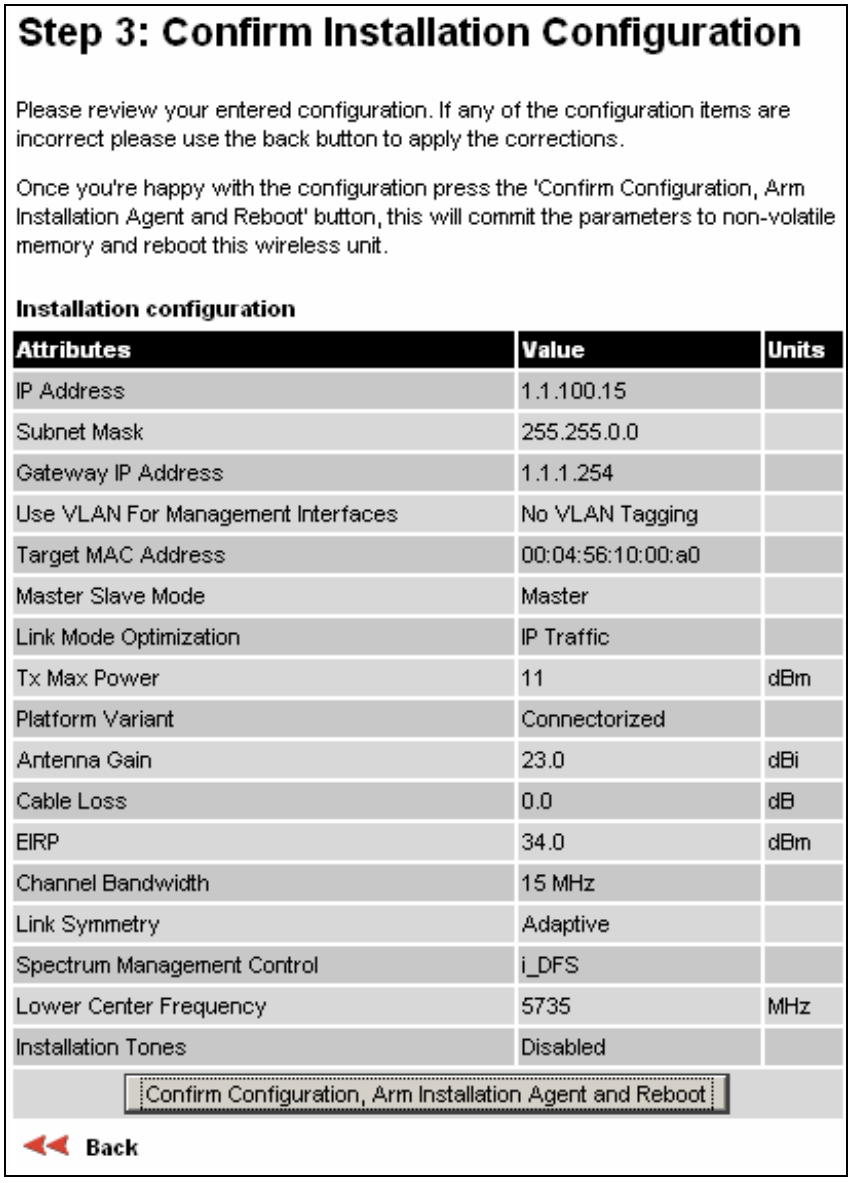
NOTE

If there is a significant difference in length of the antenna cables for the two antenna ports, then the average value should be entered.

Spectrum Management Control

Is used to configure the PTP 500 Series Bridge Spectrum Management features, see Section 7.9 “Spectrum Management” for more details. i-DFS is the abbreviation for intelligent Dynamic Frequency Selection, which continually monitors the spectrum looking for the channel with the lowest level of on channel and co-channel interference. Fixed frequency mode allows the installer to fix the Transmit and receive frequencies on the units. The frequencies may be configured symmetrically or asymmetrically.

Figure 111 - Connectorized PTP 500 Series bridge ‘Confirm Installation’ Page



Step 3: Confirm Installation Configuration

Please review your entered configuration. If any of the configuration items are incorrect please use the back button to apply the corrections.

Once you're happy with the configuration press the 'Confirm Configuration, Arm Installation Agent and Reboot' button, this will commit the parameters to non-volatile memory and reboot this wireless unit.

Installation configuration

Attributes	Value	Units
IP Address	1.1.100.15	
Subnet Mask	255.255.0.0	
Gateway IP Address	1.1.1.254	
Use VLAN For Management Interfaces	No VLAN Tagging	
Target MAC Address	00:04:56:10:00:a0	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
Tx Max Power	11	dBm
Platform Variant	Connectorized	
Antenna Gain	23.0	dBi
Cable Loss	0.0	dB
EIRP	34.0	dBm
Channel Bandwidth	15 MHz	
Link Symmetry	Adaptive	
Spectrum Management Control	i_DFS	
Lower Center Frequency	5735	MHz
Installation Tones	Disabled	

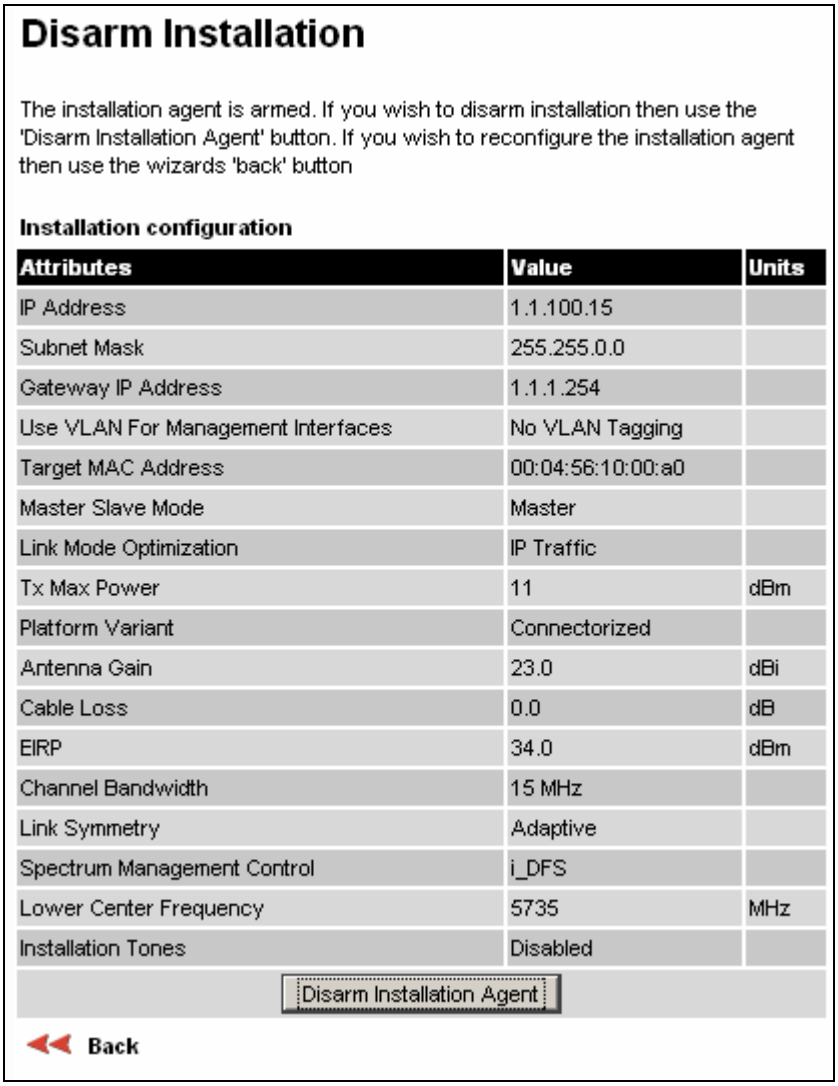
Confirm Configuration, Arm Installation Agent and Reboot

Back

EIRP

The Confirm Installation Page displays the EIRP (Effective Isotropic Radiated Power), which describes the strength of the radio signal leaving the wireless unit. This allows the operator to verify that their link configuration (Max Transmit Power, Antenna Gain and Cable Loss) do not cause the link to exceed any applicable regulatory limit.

Figure 112 - Connectorized PTP 500 Series bridge 'Disarm Installation' Page



Disarm Installation

The installation agent is armed. If you wish to disarm installation then use the 'Disarm Installation Agent' button. If you wish to reconfigure the installation agent then use the wizards 'back' button

Installation configuration

Attributes	Value	Units
IP Address	1.1.100.15	
Subnet Mask	255.255.0.0	
Gateway IP Address	1.1.1.254	
Use VLAN For Management Interfaces	No VLAN Tagging	
Target MAC Address	00:04:56:10:00:a0	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
Tx Max Power	11	dBm
Platform Variant	Connectorized	
Antenna Gain	23.0	dBi
Cable Loss	0.0	dB
EIRP	34.0	dBm
Channel Bandwidth	15 MHz	
Link Symmetry	Adaptive	
Spectrum Management Control	i_DFS	
Lower Center Frequency	5735	MHz
Installation Tones	Disabled	

Disarm Installation Agent

Back

10.3 Deployment Considerations

The majority of radio links can be successfully deployed with the PTP 500 Series. It should only be necessary to use external antennas where the LINKPlanner indicates marginal performance for a specific link – for example when the link is heavily obscured by dense woodland on an NLOS link or extremely long LOS links (>80km or >50 miles) over water.

The external antennas can be either dual-polarization (as the integrated antenna) or two single polarized antennas can be used in a spatially diverse configuration. It is expected that the dual-polarization antennas would normally be used to simplify the installation process; spatially diverse antennas may provide additional fade margin on very long LOS links where there is evidence of correlation of the fading characteristics on Vertical and Horizontal polarizations.

10.4 Link Budget

An estimate of the link budget for a specific application can be obtained by using the Motorola Systems link estimation tools. For more information see the Motorola web site.

10.5 Regulatory Issues with Connectorized Units

Installations must conform to any applicable local regulations for the Equivalent Isotropic Radiated Power (EIRP).

Ensuring compliance becomes more complex when the connectorized unit is used with external antennas which may be locally sourced. With higher gain external antennas fitted, the Maximum Transmit power may need to be reduced for operation in specific countries.

In some regions, operation of the PTP 500 products is constrained by EIRP limits. For more information on these limits, see Section 4.2 “Licenses and Region Codes”.

When operating with external antennas, the installer/operator has to set the maximum transmit power to ensure that the EIRP limit is not exceeded. Use this formula:

Maximum Transmit Power Allowed = EIRP Limit – Antenna Gain + Cable Losses

Set the power to the 1dB value lower than the actual value calculated.

10.5.1 Cable Losses (FCC Regions Only)

The FCC approval for the product is based on tests with a cable loss between the units of not less than 1.2 dB at 5.8 GHz. The use of lower cable losses would result in the installation being outside the FCC rules. As an indication, 1.2 dB of cable loss corresponds to the following cable lengths, excluding connector losses (source: Times Microwave).

Table 17 - Cable Losses per Length

Cable	Length for 1.2dB Cable Loss at 5.8 GHz	
	(ft)	(m)
LMR100	1.9	0.6
LMR200	4.6	1.4
LMR300	7.25	2.2
LMR400	11.1	3.4
LMR600	16.5	5.0

10.6 Antenna Choices

The main selection criterion is the required antenna gain. The secondary criterion is the ease of mounting and alignment. For example, the Radio Waves Parabolic dishes are supplied with a mount that allows adjustment for alignment independent of the actual antenna mounting. This type of antenna is much easier to align than those that have to be rotated around the mounting pole for alignment.

In non-FCC regions, antenna choice is not restricted, but any region specific EIRP limit must be obeyed by reducing the maximum Transmit power, see Section 4.2 “Licenses and Region Codes”.

In FCC regions, antenna choice is restricted as described in Sections 16.2.8 “PTP 54500 FCC Antenna Restrictions” and 16.3.8 “PTP 58500 FCC Antenna Restrictions”.

The maximum permitted antenna gain depends upon product variant as follows:

- PTP 58500: 37.7 dB
- PTP 54500: 34.9 dB

10.7 Installation

The section covers the generic installation instructions for the Connectorized versions of the PTP 500 Series point-to-point wireless Ethernet bridges. The actual installation procedure will depend on antenna choice, cable choice, required antenna separation etc.

Sections 16.2.8 “PTP 54500 FCC Antenna Restrictions” and 16.3.8 “PTP 58500 FCC Antenna Restrictions” show a wide variety of antennas that can be used with the Connectorized PTP 500 Series bridge.

10.7.1 Cables and Connectors

Cables should be selected using the above criteria. However it should be noted that a cable of a type similar to LMR400 is a lot more difficult to handle and route than a cable of a type similar to LMR100.

Motorola recommends the use of weatherproof connectors -- preferably, ones that come supplied with adhesive lined heat shrink sleeve that is fitted over the cable/connector interface.

The connectors required at the Connectorized PTP 500 Series bridge end of the antenna cables are N-Type Male.

The connectors required at the antenna end of the antenna cables is dependant on the antenna type chosen.

10.7.2 Tools

The tools required for mounting a Connectorized PTP 500 Series bridge unit are the same as those required for an Integrated PTP 500 Series bridge detailed in Section 6.3 ”Preparation”. The tools required for mounting the antennas are specific to the antenna chosen. The installer should refer to the antenna manufacturer’s instructions.

10.7.3 Miscellaneous supplies

The following miscellaneous supplies will be required:

- Cable ties, cable cleats – for securing cables
- Self-amalgamating tape – to weatherproof the RF connectors
- PVC tape – for additional protection of the RF connectors and securing cables

10.7.4 Mounting the Connectorized PTP 500 Series Bridge

A Connectorized PTP 500 Series bridge is shipped with the same bracket as supplied with an Integrated unit. Details on the use of this bracket can be found in Section 2.12 “Mounting Brackets”. The PTP 500 Series Bridge should be mounted in a position that gives it maximum protection from the elements, but still allows easy access for making off the various connections and applying the recommended weatherproofing.

When using dual polar antennas the Connectorized PTP 500 Series bridge should be mounted in such a position as to minimize the cable length, keeping losses to a minimum, taking into account the minimum cable lengths required by the FCC regulations, see Section 16.3.8 “PTP 58500 FCC Antenna Restrictions”.

When using separate antennas the Connectorized PTP 500 Series Bridge should be mounted in such a position as to minimize both cable runs between the unit and the antennas. It is not necessary to mount the Connectorized PTP 500 Series Bridge at the mid point between the antennas.

10.7.5 Mounting the antennas

The Antennas should be mounted according to the manufacturer’s instructions. Actual antenna position will depend on the available mounting positions and link requirements. It may be necessary to mount the antennas 20m apart or at a certain distance from the ground to get the desired results.

10.7.6 Alignment Process

When aligning antennas deployed with a Connectorized PTP 500 Series bridge unit it may not be possible to hear the alignment tone emanating from the unit. In this case it may be necessary for a second installer to assist in the operation. Alternatively, it may be possible to extend the tube on the supplied stethoscope to give a longer reach.

NOTE

Fine antenna alignment can sometimes be achieved by tightening and loosening the bolts on either side of the antenna mounting bracket, rather than trying to turn the whole bracket on the mounting pole.

10.7.7 Aligning Dual Polar Antennas

The process for aligning a dual polar antenna is the same as aligning an Integrated unit with an integrated antenna. This procedure is detailed in Section 6.6.1 “Aligning the PTP 500 Series Bridge ODUs”.

10.7.8 Aligning Separate Antennas

When using separate antennas to achieve spatial diversity, one should be mounted with Horizontal polarization and the other with Vertical polarization.

The following steps should be followed:

1. Mount the Antennas
2. Mount the connectorized version of the PTP 500 Series Bridge unit
3. Route and make off the ends of the Antenna cables
4. Connect the antenna cables at the antennas
5. Connect one of the antenna cables at the Connectorized version of the PTP 500 Series bridge unit.
6. Connect the Connectorized PTP 500 Series Bridge ODU to PIDU Plus cable and configure the unit as described in Section 6.5 “Connecting Up”.
7. Align the connected antenna using the tones as described in Section 6.6.1 “Aligning the PTP 500 Series Bridge ODUs”.

8. Connect the other antenna to the Connectorized PTP 500 Series bridge.

9. Disconnect the cable to the already aligned antenna.

10. Align the second antenna using the tones as described in Section 6.6.1 “Aligning the PTP 500 Series Bridge ODUs”.

11. Re-connect the second antenna to the Connectorized PTP 500 Series bridge. You will notice the tone pitch increase as you re-connect the second antenna due to the additional received signal.

12. Use the relevant status web pages to check that you are getting the results you expect from your link planning.

13. Complete the installation as detailed below.

10.7.9 Completing the Installation

The installation should be completed by checking all mounting nuts bolts and screws, securing all cables and weatherproofing the installation.

⚠ CAUTION

Finally tightening the antenna mountings may cause the antenna alignment to be altered, due to distortion in the mounting bracket caused by action of tightening. It is recommended that the installation tone be left turned on (armed) during this process so that any movement can be noticed and counteracted by tightening the other side of the bracket.

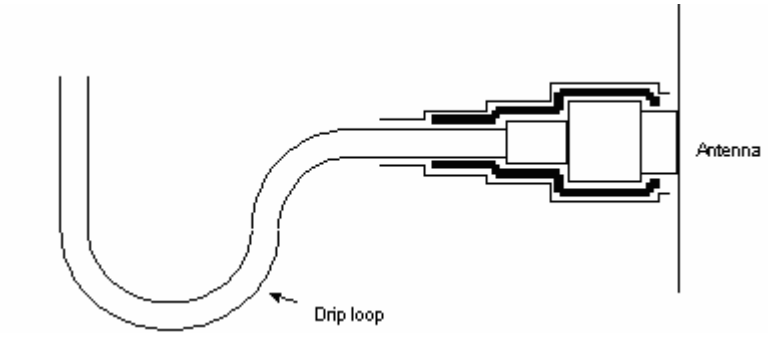
10.7.10 Antenna Cable Fixing

Cables should be secured in place using cable ties, cleats or PVC tape. Care should be taken to ensure that no undue strain is placed on the connectors on both the Connectorized PTP 500 Series bridge and the Antennas and also to ensure that the cables do not flap in the wind. Flapping cables are prone to damage and induce unwanted vibrations in the mast to which the units are attached.

10.7.11 Antenna Connection Weatherproofing

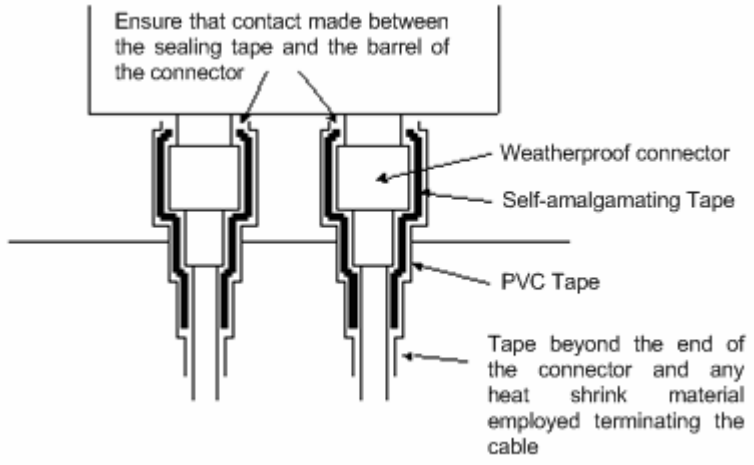
Where a cable connects to an antenna or unit from above, a drip loop should be left to ensure that water is not constantly channeled towards the connector.

Figure 113 - Forming a Drip Loop



All joints should be weatherproofed using self-amalgamating tape. It is recommended that a layer of PVC tape be placed over the self-amalgamating tape to protect the joint while the self-amalgamating tape cures and gives additional protection. Figure 114 shows this diagrammatically for the PTP 500 Series bridge end of the antenna cables. If the antenna manufacturer has not supplied guidance on this matter, the same technique should be employed at the antenna end of the cable.

Figure 114 - Weatherproofing the Antenna Connections



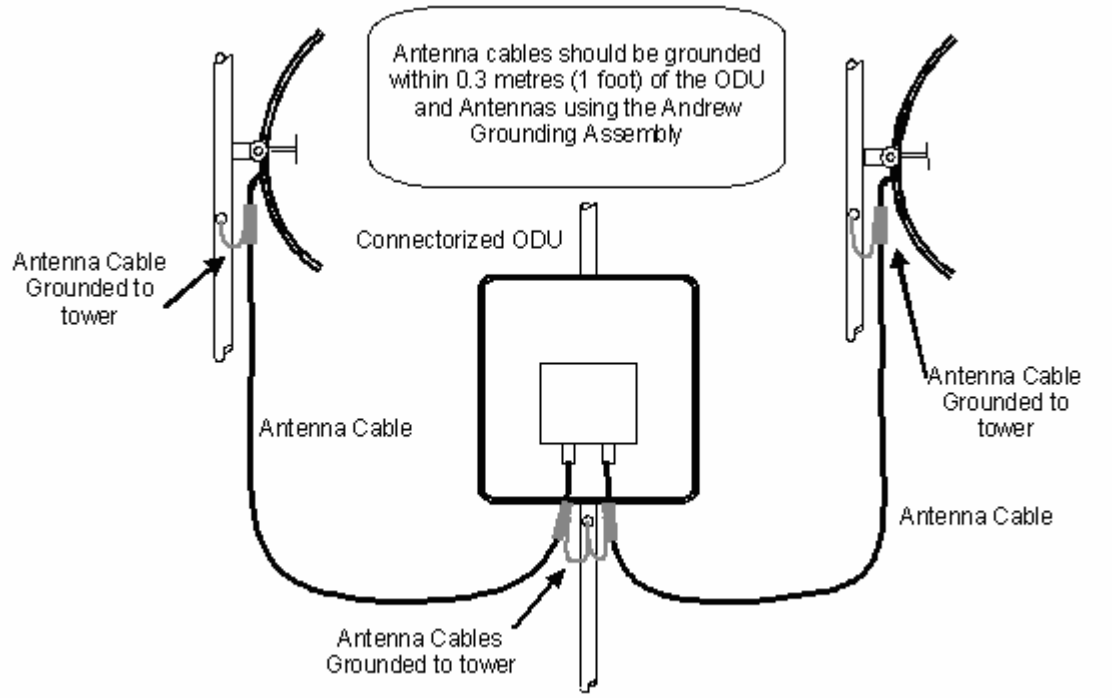
10.8 Additional Lightning Protection

The following guidelines should be applied in addition to those described in Section 5 ”Lightning Protection”.

10.8.1 ODU Mounted Outdoors

Where the ODU is mounted outdoors and is mounted some distance from the antenna, it is advisable to add additional grounding by utilizing Andrew Assemblies (such as Andrew Type 223158 www.andrew.com) as shown in Figure 115.

Figure 115- Additional Grounding When Using Connectorized Units



NOTE

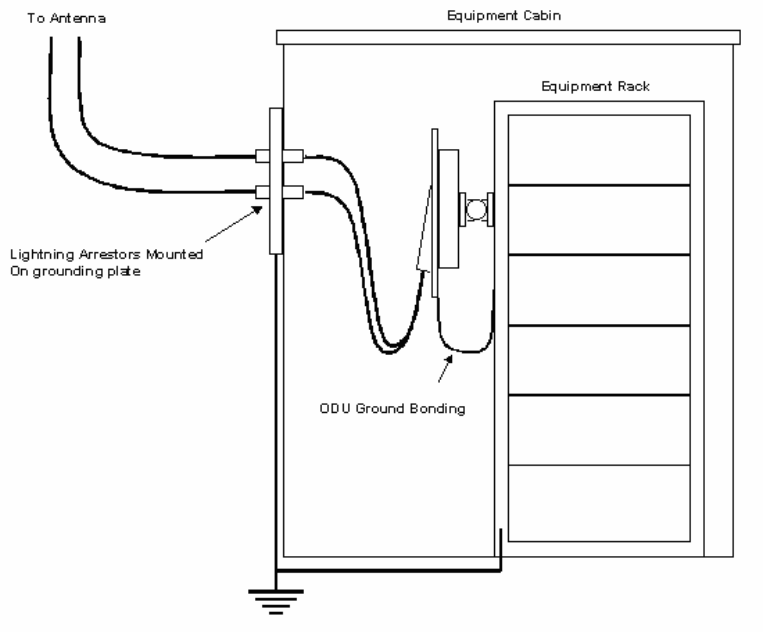
Refer to instructions contained in the Andrew grounding kit for correct installation, or if instructions are missing, refer to:

http://awapps.commscope.com/catalog/product_details.aspx?id=15832&tab=2

10.8.2 ODU Mounted Indoors

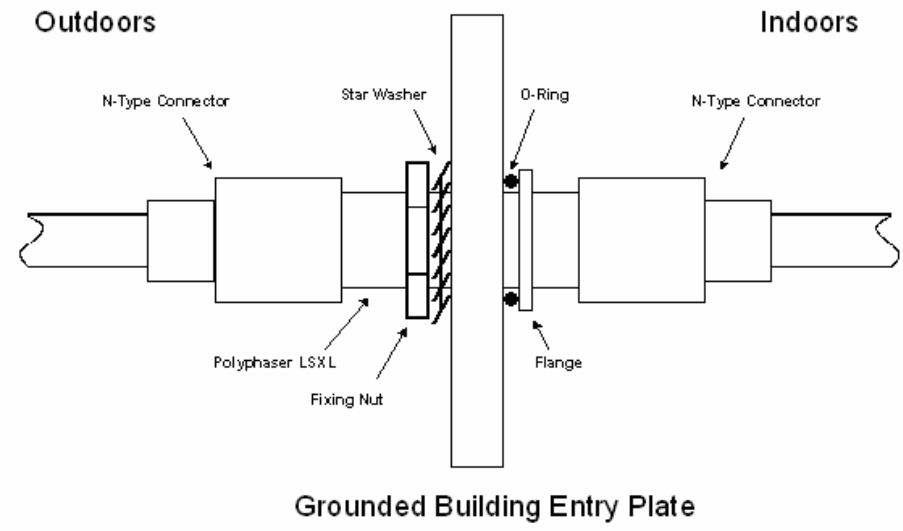
Where the ODU is mounted indoors, lightning arrestors should be deployed where the antenna cables enter the building as shown in Figure 116.

Figure 116 - Lightning Arrestor Mounting



The lighting arrestors should be ground bonded to the building ground at the point of entry. Motorola recommends Polyphaser LSXL-ME or LSXL lighting arrestors. These should be assembled as show in Figure 117.

Figure 117 - Polyphaser Assembly



11 E1/T1 Installation Guide

This section describes the installation and configuration of the E1/T1 interface.

The following topics are described in this section:

- 11.1 E1/T1 Cable Assembly
- 11.2 Connecting the E1/T1 Cable to the PIDU Plus
- 11.3 Testing the E1/T1 Installation

NOTE

The maximum cable length between the ODU and the customers terminating equipment is 200m (656 feet) for E1/T1.

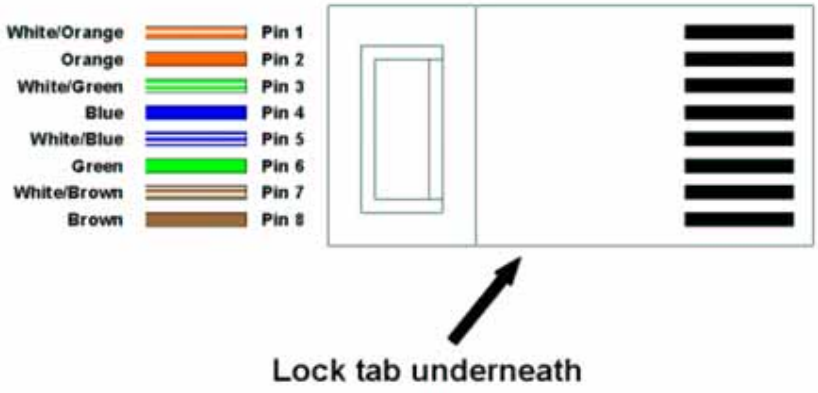
11.1 E1/T1 Cable Assembly

The E1/T1 cable should be assembled as described in Section 2.10 “Cables and Connectors”. This procedure applies to the ODU termination, but it must be repeated for the customer equipment end of the cable when the cable is terminated with an RJ45.

11.1.1 T568B Color Coding

The T568B color coding used in RJ45 E1/T1 cables is illustrated in Figure 118.

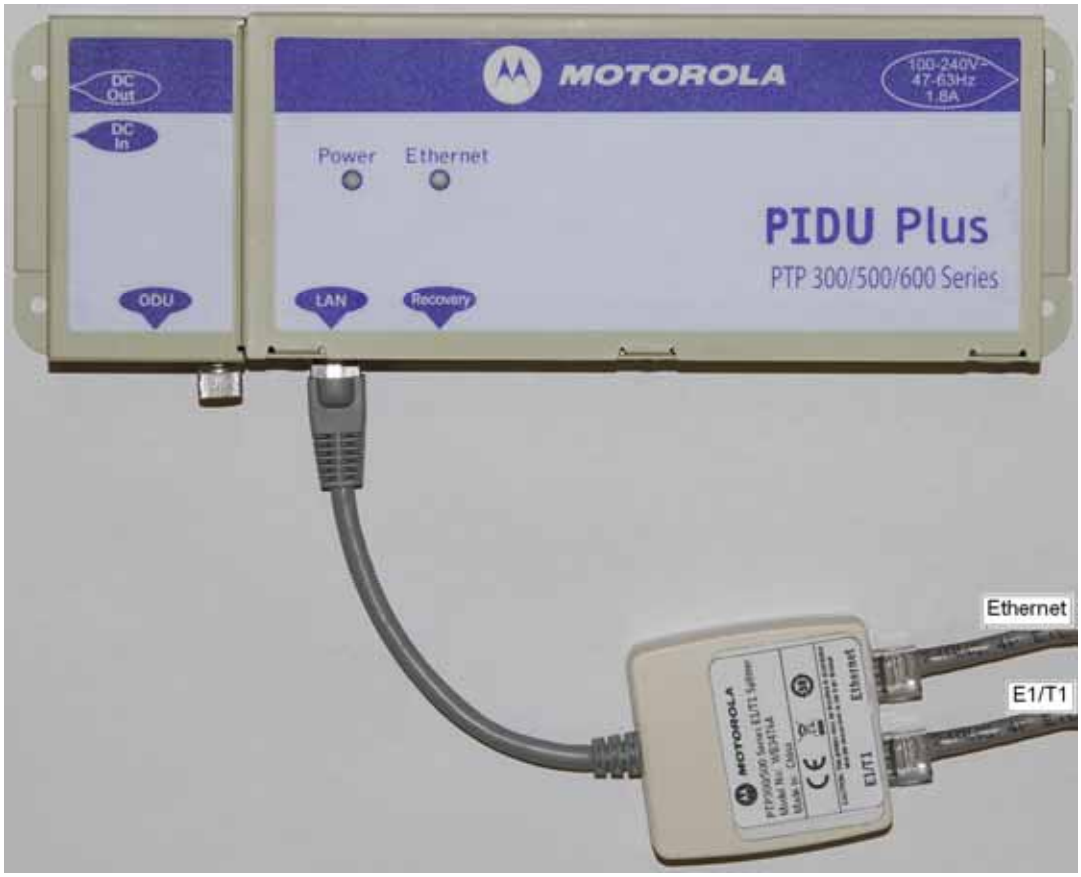
Figure 118 - RJ45 Pin Connection (T568B Color Coding)



11.2 Connecting the E1/T1 Cable to the PIDU Plus

The E1/T1 cable and the Ethernet cable share the LAN port of the PIDU Plus. They are connected via the PTP 300/500 Series E1/T1 Splitter (Figure 119).

Figure 119 - PIDU Plus and E1/T1 Connexion



Ensure no power is connected to the PIDU Plus or present in the cable before connecting the E1/T1 Splitter.

11.2.1 E1/T1 Splitter Output Pin Connections

The E1/T1 splitter output pin connections are specified in Table 18.

Table 18 – E1/T1 Splitter Output Pin Connections

Port	Pin Number	Connection
Ethernet	1	Rx1
	2	Rx2
	3	Tx1
	4	
	5	
	6	Tx2
	7	
	8	
E1/T1	1	Rx Ring
	2	Rx Tip
	3	
	4	Tx Ring
	5	Tx Tip
	6	
	7	
	8	

11.3 Testing the E1/T1 Installation

Test the telecoms links by performing loopback connections as described in Section 7.5.5 “Telecoms Configuration”.

12 Data Rate Calculations

This section provides instructions, tables and graphs to allow calculation of the data rate capacity that can be provided by alternative PTP 500 configurations.

The following topics are described in this section:

- 12.1 Data Rate Defined
- 12.2 Calculation Procedure and Example
- 12.3 Data Throughput Capacity
- 12.4 Range Adjustment Curves

12.1 Data Rate Defined

The data rate capacity of a PTP link is defined as the maximum end-to-end Ethernet throughput (including Ethernet headers) that it can support. It is assumed that Ethernet frames are 1500 octet. Data rate capacity is determined by the following factors:

- Link Symmetry
- Link Mode Optimization (IP or TDM)
- Modulation Mode
- Channel Bandwidth
- Link Range

12.2 Calculation Procedure and Example

12.2.1 Procedure

To calculate the data rate capacity of a PTP 500 link, follow this procedure:

1. Use the tables in Section 12.3 to look up the data throughput capacity rates (Tx, Rx and Both) for the required combination of:
   - Link Symmetry
   - Link Mode Optimization
   - Modulation Mode
   - Channel Bandwidth

2. The tables in Section 12.3 contain data rates for links of zero range. Use the curves in Section 12.4 to look up the Throughput Factor that must be applied to adjust the data rates for the actual range of the link.

3. Multiply the data rates by the Throughput Factor to give the throughput capacity of the link.

NOTE

There is a small difference between the rates for IP and TDM because there is fragmentation in TDM (for low priority traffic) which causes the throughput to be reduced buy approximately 1% compared to the IP mode.

12.2.2 Example

Suppose that the link characteristics are:

- Link Symmetry = 1:1
- Link Mode Optimization = TDM
- Modulation Mode = 64QAM 0.83 Dual
- Channel Bandwidth = 10 MHz
- Link Range = 55 km

Applying the calculation procedure:

1. Use Table 21 to look up the data throughput capacity rates (Mbit/s):

Tx = 32.78	Rx = 32.78	Both = 65.56

2. Use Figure 121 to look up the Throughput Factor for 1:1, TDM and Link Range 55 km. The factor is 0.7.

3. Multiply the rates from Step 2 by the Throughput Factor from Step 3 to give the throughput capacity of the link (Mbit/s):

Tx = 22.95	Rx = 22.95	Both = 45.89

(If the product is a PTP 500 Lite, divide these figures by 2).

12.3 Data Throughput Capacity

Table 19, Table 20 and Table 21 show the data throughput rates (Mbits/s) that are achieved when two PTP 500 ODUs are linked and the link distance (range) is 0 km. Use the curves in Section 12.4 to adjust these figures to allow for link range.

Throughput for Link Symmetry 3:1 is the same as that for 1:3, but the Tx and Rx data rates are swapped.

All data rates are quoted in Mbit/s.

PTP 500 Lite data rates are half the PTP 500 Full rates given in this section.

Table 19 – Data Throughput for PTP 500, Link Symmetry = Adaptive or 3:1

PTP 500 Full:									
	15 MHz			10 MHz			5 MHz		
Modulation Mode	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
64QAM 0.83 Dual	77.48	25.60	103.08	51.84	16.81	68.65	Not supported		
64QAM 0.67 Dual	62.00	20.21	82.21	41.07	13.46	54.53			
16QAM 0.75 Dual	46.47	15.47	61.94	30.98	10.07	41.05			
16QAM 0.50 Dual	30.99	10.08	41.07	20.20	6.72	26.92			
QPSK 0.75 Dual	22.90	7.38	30.28	15.46	4.68	20.14			
64QAM 0.83 Single	38.38	12.77	51.15	25.59	8.07	33.66			
64QAM 0.67 Single	30.99	10.08	41.07	20.20	6.72	26.92			
16QAM 0.75 Single	22.90	7.38	30.28	15.46	4.68	20.14			
16QAM 0.50 Single	15.47	4.68	20.15	10.07	3.34	13.41			
QPSK 0.75 Single	11.43	3.34	14.77	7.38	1.99	9.37			
QPSK 0.50 Single	7.38	1.99	9.37	4.68	1.34	6.02			
BPSK 0.50 Single	3.34	0.64	3.98	1.99	0.64	2.63			

Table 20 – Data Throughput for PTP 500, Link Symmetry = 1:1, Link Optimization = IP

PTP 500 Full:									
	15 MHz			10 MHz			5 MHz		
Modulation Mode	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
64QAM 0.83 Dual	51.86	51.86	103.72	34.33	34.33	68.66	16.79	16.79	33.58
64QAM 0.67 Dual	41.08	41.08	82.16	27.58	27.58	55.16	13.45	13.45	26.90
16QAM 0.75 Dual	30.99	30.99	61.98	20.20	20.20	40.40	10.06	10.06	20.12
16QAM 0.50 Dual	20.21	20.21	40.42	13.46	13.46	26.92	6.72	6.72	13.44
QPSK 0.75 Dual	15.47	15.47	30.94	10.07	10.07	20.14	4.67	4.67	9.34
64QAM 0.83 Single	25.60	25.60	51.20	16.81	16.81	33.62	8.06	8.06	16.12
64QAM 0.67 Single	20.21	20.21	40.42	13.46	13.46	26.92	6.72	6.72	13.44
16QAM 0.75 Single	15.47	15.47	30.94	10.07	10.07	20.14	4.67	4.67	9.34
16QAM 0.50 Single	10.08	10.08	20.16	6.72	6.72	13.44	3.33	3.33	6.66
QPSK 0.75 Single	7.38	7.38	14.76	4.68	4.68	9.36	1.99	1.99	3.98
QPSK 0.50 Single	4.68	4.68	9.36	3.34	3.34	6.68	1.34	1.34	2.68
BPSK 0.50 Single	1.99	1.99	3.98	1.34	1.34	2.68	0.64	0.64	1.28

Table 21 – Data Throughput for PTP 500, Link Symmetry = 1:1, Link Optimization = TDM

PTP 500 Full:									
	15 MHz			10 MHz			5 MHz		
Modulation Mode	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
64QAM 0.83 Dual	49.56	49.56	99.12	32.78	32.78	65.56	16.79	16.79	33.58
64QAM 0.67 Dual	39.25	39.25	78.50	26.34	26.34	52.68	13.45	13.45	26.90
16QAM 0.75 Dual	29.61	29.61	59.22	19.28	19.28	38.56	10.06	10.06	20.12
16QAM 0.50 Dual	19.31	19.31	38.62	12.85	12.85	25.70	6.72	6.72	13.44
QPSK 0.75 Dual	14.78	14.78	29.56	9.62	9.62	19.24	4.67	4.67	9.34
64QAM 0.83 Single	24.46	24.46	48.92	16.05	16.05	32.10	8.06	8.06	16.12
64QAM 0.67 Single	19.31	19.31	38.62	12.85	12.85	25.70	6.72	6.72	13.44
16QAM 0.75 Single	14.78	14.78	29.56	9.62	9.62	19.24	4.67	4.67	9.34
16QAM 0.50 Single	9.63	9.63	19.26	6.42	6.42	12.84	3.33	3.33	6.66
QPSK 0.75 Single	7.05	7.05	14.10	4.47	4.47	8.94	1.99	1.99	3.98
QPSK 0.50 Single	4.47	4.47	8.94	3.19	3.19	6.38	1.34	1.34	2.68
BPSK 0.50 Single	1.90	1.90	3.80	1.28	1.28	2.56	0.64	0.64	1.28

12.4 Range Adjustment Curves

Use these graphs to look up the link Range and find the Throughput Factor that must be applied to adjust the 0 km data throughput rates for the required combination of Link Mode Optimization (IP or TDM) and Link Range (km).

Curve A (Figure 120) is used when one of the following conditions applies:

- Link Symmetry = 3:1
- Link Symmetry = 1:1 and Link Optimization = IP
- Link Symmetry = 1:3

Curve B (Figure 121) is used only when Link Symmetry = 1:1 and Link Optimization = TDM.

Figure 120 – PTP 500 Range Adjustment for Data Rates, Curve A

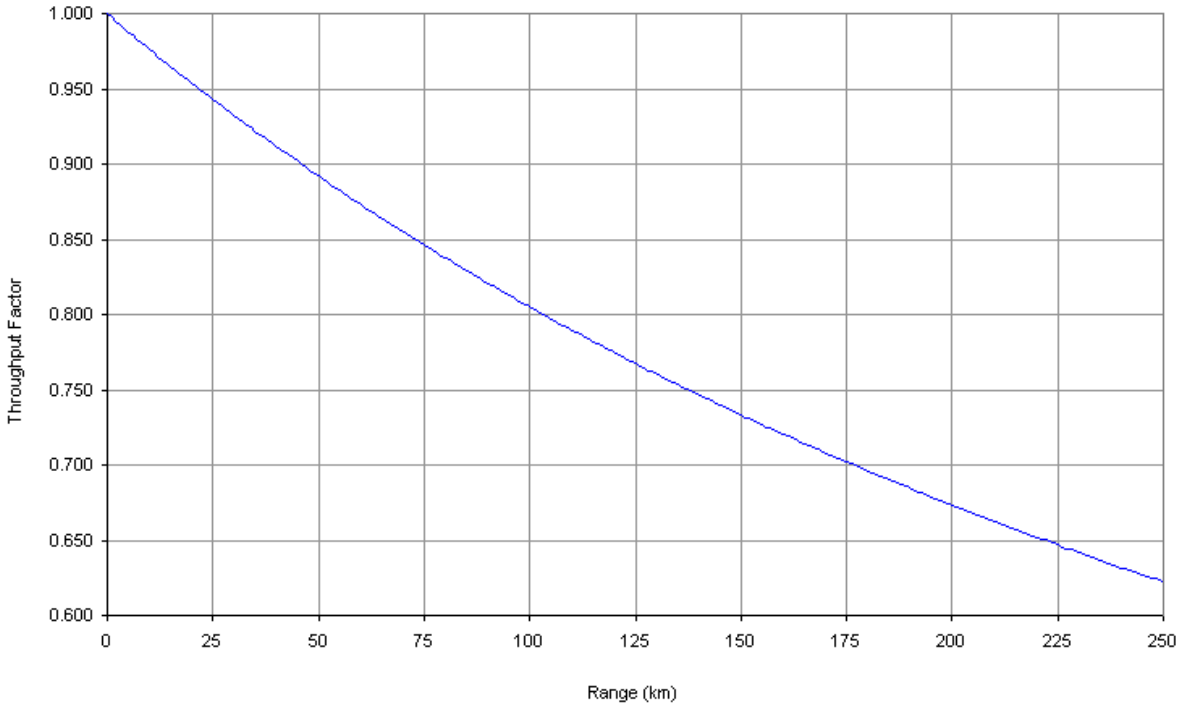
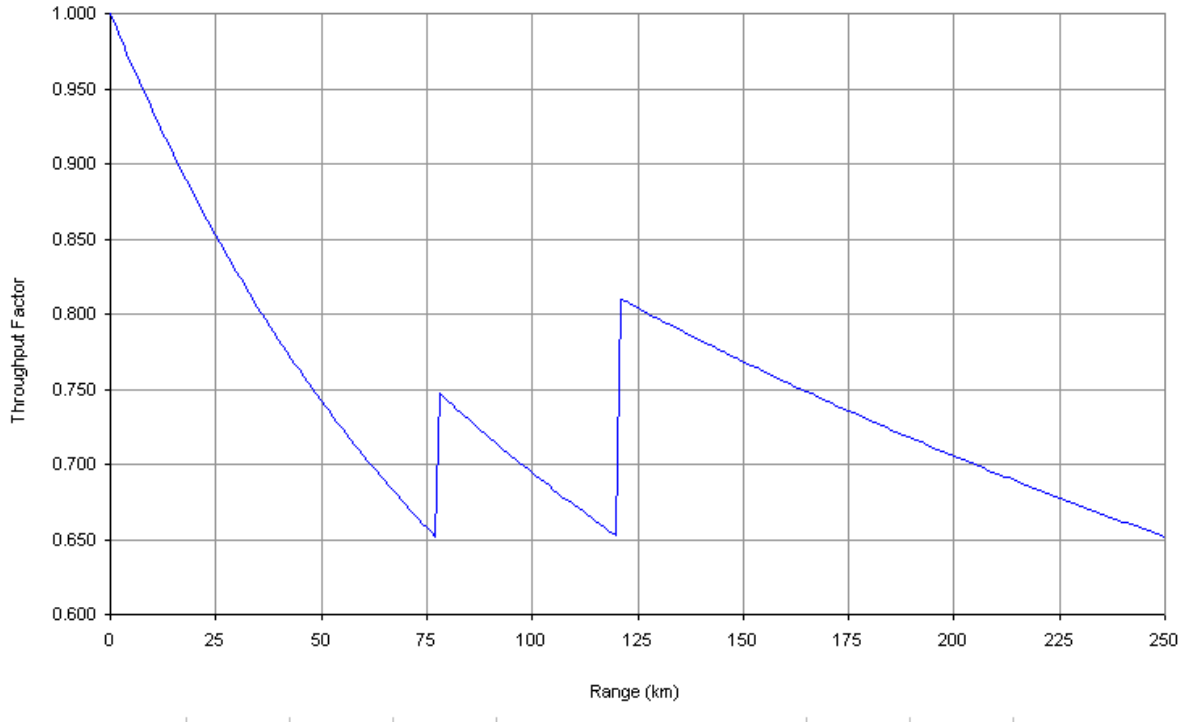


Figure 121 – PTP 500 Range Adjustment for Data Rates, Curve B



13 AES Encryption

This section describes how to encrypt a PTP 500 link.

The following topics are described in this section:

- 13.1 Encryption Standard Used
- 13.2 Upgrading for Link Encryption
- 13.3 Configuring Link Encryption
- 13.4 Wireless Link Encryption FAQ

13.1 Encryption Standard Used

The Motorola PTP 500 Series bridges support link encryption using the NIST approved Advanced Encryption Standard, HFIPS-197.H. This standard specifies AES (Rijndael) as a FIPS-approved symmetric encryption algorithm that may be used by U.S. Government organizations (and others) to protect sensitive information.

13.2 Upgrading for Link Encryption

Link Encryption is not available in the standard PTP 500 Series system. A license key to enable link encryption can be purchased from your Motorola Point-to-Point Distributor or Solutions Provider. AES can be activated on receipt of the activation on the Motorola Systems Support Page.

There are two levels of encryption that are available to purchase:

- 128-bit
- 128 and 256-bit

Option 1 allows the user to encrypt all traffic sent over the wireless link using 128-bit encryption. Option 2 allows the user to encrypt traffic using either 128 or 256-bit encryption. The configuration process for both encryption variants is identical except for the selection of algorithm. The following configuration example is for a 256-bit encryption key.

13.3 Configuring Link Encryption

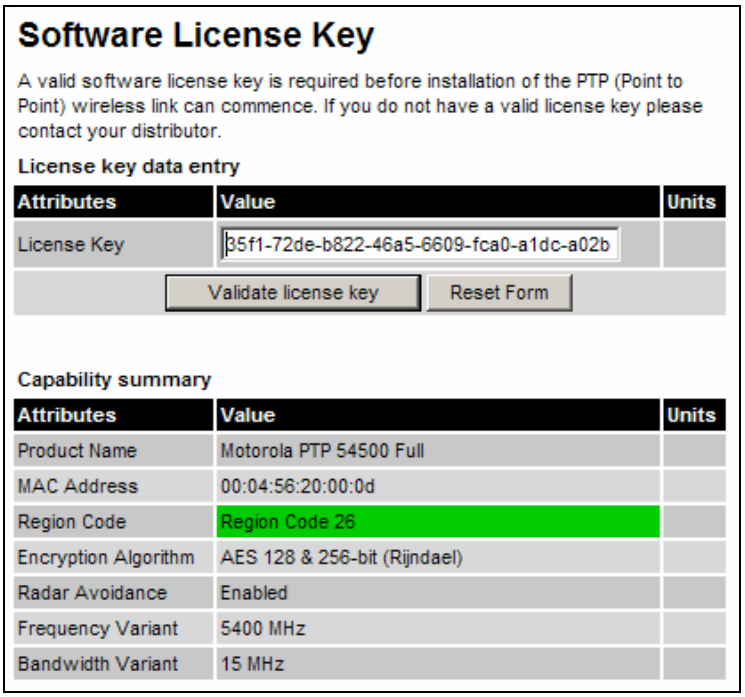
After purchasing AES encryption for the PTP 500 Series wireless link, two new license keys will be issued, one for each end of the wireless link. The following configuration process gives a step by step guide to enabling AES link encryption on a PTP 500 Series bridge.

13.3.1 License Keys

The first step when configuring link encryption is to enter the new license keys in both PTP 500 Series wireless units.

Figure 122 shows the license key data entry screen. This screen can only be accessed by the system administrator. If you do not have access to the PTP 500 Series system administration pages then please contact your designated system administrator.

Figure 122 – AES Software License Key Data Entry



Configuring link encryption will necessitate a PTP 500 Series bridge service outage. Therefore it is recommended that the configuration process be scheduled during an appropriate period of low link utilization.

Motorola recommends the following process for entering new license keys and minimizing service outage:

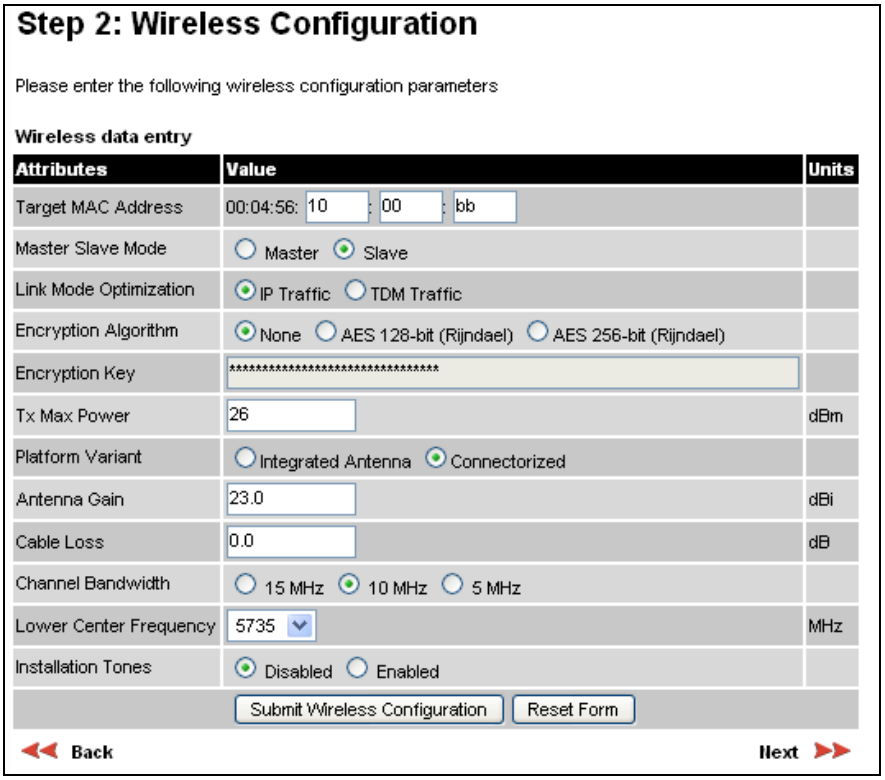
1. Open two browsers, one for each end of the link
2. Navigate to the ‘License Key’ data entry page for each end of the link
3. Enter the license keys and click the ‘Validate license key’ button at each end of the link. This will allow the software to validate the license key prior to the system reset. (DO NOT CLICK ARE YOU SURE POPUP DIALOG)
4. When both license keys have been successfully validated, confirm the reboot for both ends of the link. The software is designed to allow five seconds so that a user can command both ends of the link to reset before the wireless link drops.

The link will automatically re-establish.

13.3.2 Encryption Mode and Key

Entering the license keys only does not initialize AES link encryption. Link encryption can only be enabled via the Configuration or Installation Wizard pages. Motorola recommends that the Configuration page Figure 123 be used to configure AES link encryption.

Figure 123 – AES Configuration Data Entry Page



To enter AES link encryption configuration, follow this procedure:

1. Open two browsers, one for each end of the link

2. Navigate to the ‘Configuration’ data entry page for each end of the link

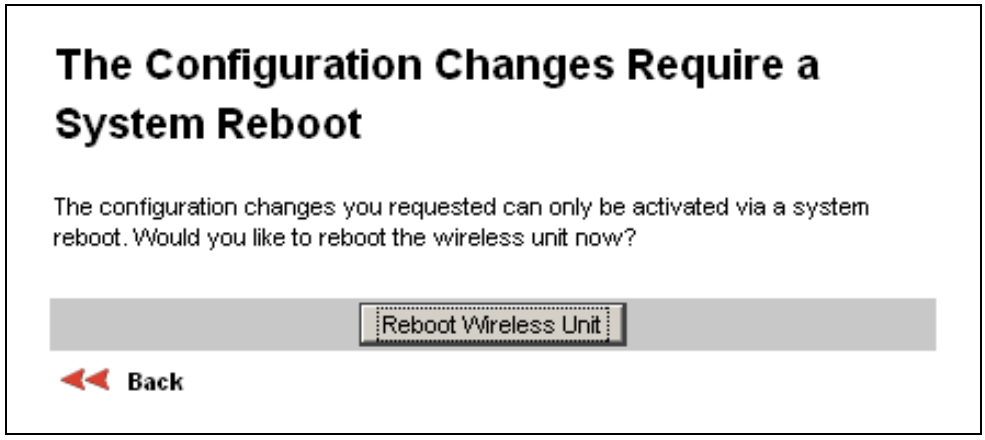
3. At both ends of the link select the ‘AES (Rijndael)’ Encryption Algorithm required.

4. At both ends of the link enter ether an 128-bit or 256-bit encryption key. Note the key consists of 32/64 case insensitive hexadecimal characters. The same Key must be entered at both ends of the link. Failure to enter the same key will cause the link to fail.

5. Submit configuration on both ends of the link, but do not reboot.

6. Reboot both ends of the link Figure 124. The software is designed to allow five seconds so that a user can command both ends of the link to reboot before the wireless link drops.

Figure 124 - Configuration Reboot Screen



13.4 Wireless Link Encryption FAQ

13.4.1 Encryption data entry fields are not available

Check that the correct license key has been inserted into the unit. The current license key is displayed on the 'License Key' data entry page.

13.4.2 Link fails to bridge packets after enabling link encryption

If the wireless link status on the status web page indicates that the link is 'Searching', and you can browse to the local end of the link but not to the remote end, then check that the same encryption algorithm and key have been entered at both ends of the link. Failure to enter the same algorithm and key will result in received packets not being decrypted correctly.

13.4.3 Loss of AES following downgrade

When downgrading (using Recovery software image 05-01 onwards) to an earlier version of software that does not support AES, the unit will indicate that the region code is invalid. The user will be required to re-install correct software (supplied when AES key was activated) and reboot the unit.

14 Remote Software Upgrade by TFTP

This section describes how to upgrade the PTP 500 software remotely using Trivial FTP (TFTP) triggered by SNMP.

To perform a remote software upgrade, follow this procedure:

1. Set the following tFTP attributes:

   tFTPServerIPAddress: The IP address of the TFTP server from which the TFTP software upgrade file Name will be retrieved. For example, to set the TFTP server IP address for unit 10.10.10.10 to 10.10.10.1:

   `snmpset_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.5.0 a 10.10.10.1`

   tFTPServerPortNumber: This setting is optional. The port number of the TFTP server from which the TFTP software upgrade file name will be retrieved (default=69).

   tFTPSoftwareUpgradeFileName: The filename of the software upgrade to be loaded from the TFTP server. For example, to set the TFTP software upgrade filename on 10.10.10.10 to "B1095.dld":

   `snmpset_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.7.0 s B1095.dld`

   tFTPStartSoftwareUpgrade: Write '1' to this attribute to start the TFTP software upgrade process. The attribute will be reset to 0 when the upgrade process has finished. Example:

   `snmpset_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.8.0 i 1`

2. Monitor the values of the following tFTP attributes:

tFTPSoftwareUpgradeStatus: The current status of the TFTP software upgrade process. Values:

- idle(0)
- uploadinprogress(1)
- uploadsuccessfulprogrammingFLASH(2)
- upgradesuccessfulreboottorunthenewsoftwareimage(3)
- upgradefailed(4).

Example:

```
snmpget_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.9.0
```

tFTPSoftwareUpgradeStatusText: This describes the status of the TFTP software upgrade process, including any error details. Example:

```
snmpget_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.10.0
```

tFTPSoftwareUpgradeStatusAdditionalText: Used if tFTPSoftwareUpgradeStatusText is full and there are more than 255 characters to report. Additional text describing the status of the TFTP software upgrade process, including any error details. Example:

```
snmpget_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.11.0
```

3. When the upgrade is complete, reboot the ODU to run the newly loaded software image. See Section 8.6 “Reboot”.

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zlib.h

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15.2 Hardware Warranty in U.S.

Motorola U.S. offers a warranty covering a period of one year from the date of purchase by the customer. If a product is found defective during the warranty period, Motorola will repair or replace the product with the same or a similar model, which may be a reconditioned unit, without charge for parts or labor.

15.3 Limit of Liability

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16 PTP 500 Reference Information

This section describes the reference information and regulatory notices that are common to all PTP 500 products and those that are specific to each frequency variant.

The following topics are described in this section:

- 16.1 PTP 500 General Reference Information
- 16.2 PTP 54500 Reference Information
- 16.3 PTP 58500 Reference Information

16.1 PTP 500 General Reference Information

16.1.1 PTP 500 System Specifications

Table 22 – PTP 500 Management Specifications

Management	Specification
Status Indication	Power status Ethernet Link Status Data activity
Installation	Web server and browser for setup. Audio tone feedback during installation , plus graphical installation tool suitable for laptop and PDA computing devices. Web server for confirmation.
Radio Performance and Management	Via web server and browser, SNMP
Alarms	Via configurable email alerts, SNMP
System Management	Web or SNMP v1/v2c using MIBII, WiMAX MIB, and a proprietary PTP MIB; Canopy Prizm.
Lightning protection	Built into the ODU; an external PTP Lightning Protection Unit (PTP-LPU) end device is required near the base of the tower or wall at the cable entrance point leading to the network.

Table 23 – PTP 500 Ethernet Bridging Specifications

Ethernet Bridging	Specification
Protocol	IEEE802.3
QoS	IEEE 802.1p (eight levels), IEEE 802.1Q, IEEE 802.1ad.
Interface	100BaseT (RJ-45), Supports MDI/MDIX Auto Crossover
Data Rates	See Section 12 “Data Rate Calculations”.
Maximum Packet Rate	50000 frames/s
Maximum Frame Lifetime	1160 ms
Maximum Ethernet Frame Size	2000 bytes

NOTE

Practical Ethernet rates will depend on network configuration, higher layer protocols and platforms used.

Over the air throughput will be capped to the rate of the Ethernet interface at the receiving end of the link.

Table 24 – PTP 500 Physical Specifications

Integrated	Specification
Dimensions	Width 14.5” (370mm), Height 14.5” (370mm), Depth 3.75” (95mm)
Weight	11.8 lbs (5.35 Kg) including bracket

Connectorized	Specification
Dimensions	Width 12.2” (309 mm), Height 12.2” (309 mm), Depth 4.01” (105 mm)
Weight	10.4 lbs (4.7 Kg) including bracket

Table 25 – PTP 500 Power Supply Specifications

Power Supply	Separate power supply unit (included)
Dimensions	Width 9.75” (250mm), Height 1.5” (40mm), Depth 3” (80mm)
Weight	1.9 lbs (0.864 Kg)
Power source	90 – 264 V ac, 50 – 60 Hz / 36 – 60 V dc
Power consumption	55 W max

16.1.2 PTP 500 Safety Compliance

Table 26 – PTP 500 Safety Compliance Specifications

Region	Specification
USA	UL 60950
Canada	CSA C22.2 No.60950
International	CB certified & certificate to IEC 60950

16.1.3 PTP 500 EMC Immunity Compliance

Top-level Specification ETSI 301-489.

Table 27 – PTP 500 EMC Immunity Compliance Specifications

Specification	Comment
EN 55082-1 Generic EMC and EMI requirements for Europe	
EN 61000-4-2: 1995 Electro Static Discharge (ESD), Class 2, 8 kV air, 4 kV contact discharge	Testing will be carried to ensure immunity to 15kV air and 8kV contact
EN 61000-4-3: 1995 ENV50140: 1993 (radiated immunity) 3 V/m	
EN 61000-4-4: 1995 (Bursts/Transients), Class 4, 4 kV level (power lines AC & DC)	Signal lines @ 0.5 kV open circuit voltage.
EN 6100045:1995, (Surge Immunity)	Requires screened connection to users network
EN 61000-4-6: 1996 (Injected RF), power line, Class 3 @ 10 V/m	Signal lines, Class 3 @ 3 V RMS un-modulated.

16.1.4 PTP 500 Environmental Specifications

Table 28 – PTP 500 Environmental Specifications

Category	Specification
Temperature	ODU: -40°F (-40°C) to 140°F (+60°C) PIDU Plus (indoor deployment): 32°F (0°C) to 104°F (+40°C) PIDU Plus (outdoor deployment within weatherproofed cabinet): -40°F (-40°C) to 140°F (+60°C)
Wind Loading	150mph Max (242kph). See Section 4.7”Wind Loading” for a full description.
Humidity	100% Condensing (ODU only)
Waterproof	IP65 (ODU only)
UV Exposure	10 year operational life (UL746C test evidence)

16.2 PTP 54500 Reference Information

This section contains reference information for the PTP 54500 frequency variant.

16.2.1 PTP 54500 Examples of Regulatory Limits

Table 29 shows how the regulatory limits currently apply in specific countries. Operators should note that regulations are subject to change.

Table 29 – PTP 54500 Examples of Regulatory Limits

Region	Examples of Regulatory Limits at 5.4GHz
FCC	Under FCC Regulations, operation of this product is only allowed with a License Key for Region 12. This implements Radar Detection in accordance with FCC Regulations and limits the EIRP to the regulatory limits below: EIRP ≤ Max of [(17 +10 x Log(Channel BW)) and 30] dBm
ETSI	Under ETSI Regulations, operation of this product is only allowed with a License Key for Region 26. This implements Radar Detection in accordance with ETSI Regulations, including barring of the band from 5600 MHz to 5650 MHz and limits the EIRP to the regulatory limits below: EIRP ≤ Max of [(17 +10 x Log(Channel BW)) and 30] dBm
Canada	Under Industry Canada Regulations, operation of this product is only allowed with a License Key for Region 13. This implements Radar Detection in accordance with Canadian Regulations, including barring of the band from 5600 MHz to 5650 MHz and limits the EIRP to the regulatory limits below: EIRP ≤ Max of [(17 +10 x Log(Channel BW)) and 30] dBm

General Notice Applicable to Europe – 5.4 GHz
This equipment complies with the essential requirements for the EU R&E Directive 1999/5/EC.

CE 1321

NOTE

In regions other than EU/USA, specific local regulations may apply. It is the responsibility of the installer/user to check that the equipment as deployed meets local regulatory requirements.

16.2.2 PTP 54500 Licenses and Region Codes

PTP 54500 units may be operated in any of the regions listed in Table 30. When shipped, PTP 54500 units are configured with a license key for Region Code 26. Alternative license keys are provided in the Deployment Guide for Region Codes 12 and 13. If the link is to be installed in any other permitted region, the user must obtain a new license key from the reseller or distributor.

Table 30 – PTP 54500 Licenses and Region Codes

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
7	Full Power + Radar	5470 - 5600 MHz 5650 - 5725 MHz	Yes	5, 10, 15 MHz	27 dBm	
8	Full Power	5470 - 5725 MHz		5, 10, 15 MHz	27 dBm	
12	FCC USA	5470 - 5725 MHz	Yes	5 MHz	23 dBm EIRP	
				10 MHz	26 dBm EIRP	
				15 MHz	28 dBm EIRP	
13	Australia, Canada	5470 - 5600 MHz 5650 - 5725 MHz	Yes	5 MHz	23 dBm EIRP	The band 5600 MHz to 5650 MHz is reserved for the use of weather radars
				10 MHz	26 dBm EIRP	
				15 MHz	28 dBm EIRP	
20	Thailand	5470 - 5725 MHz		5, 10, 15 MHz	30 dBm EIRP	
26	ETSI	5470 - 5600 MHz 5650 - 5725 MHz	Yes	5 MHz	23 dBm EIRP	The band 5600 MHz to 5650 MHz is reserved for the use of weather radars
				10 MHz	26 dBm EIRP	
				15 MHz	28 dBm EIRP	

16.2.3 PTP 54500 Regulatory Compliance

The PTP 54500 complies with the regulations that are in force in the USA, Canada and Europe. The relevant notifications are specified in this section.

16.2.3.1 PTP 54500 FCC and IC Notification

U.S. Federal Communication Commission (FCC) and Industry Canada (IC) Notification.

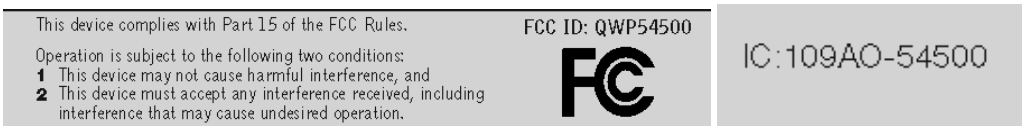
This device complies with FCC Part 15 for the USA and RSS-210 Issue 7 of Industry Canada. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation. In Canada, users should be cautioned to take note that high power radars are allocated as primary users (meaning they have priority) of 5250 – 5350 MHz and 5470 – 5725 MHz and these radars could cause interference and/or damage to license-exempt local area networks (LELAN).

For the connectorized version of the product and in order to reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that permitted by the regulations. The transmitted power must be reduced to achieve this requirement.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US FCC Rules and with RSS-210 of Industry Canada. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

FCC IDs and Industry Canada Certification Numbers are listed below:



16.2.3.2 PTP 54500 European Union Notification

The PTP 54500 product is a two-way radio transceiver suitable for use in Broadband Wireless Access System (WAS), Radio Local Area Network (RLAN), or Fixed Wireless Access (FWA) systems. It is a Class 1 device and uses operating frequencies that are harmonized throughout the EU member states. The operator is responsible for obtaining any national licenses required to operate this product and these must be obtained before using the product in any particular country.

This equipment complies with the essential requirements for the EU R&TTE Directive 1999/5/EC and has been tested compliant with EuroNorm EN 301 893. The declaration of conformity may be consulted at http://motorola.canopywireless.com/doc.php.

This equipment is marked to show compliance with the European R&TTE directive 1999/5/EC.



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European Union (EU) Waste of Electrical and Electronic Equipment (WEEE) directive

The European Union's WEEE directive requires that products sold into EU countries must have the crossed out trash bin label on the product (or the package in some cases). As defined by the WEEE directive, this cross-out trash bin label means that customers and end-users in EU countries should not dispose of electronic and electrical equipment or accessories in household waste. Customers or end-users in EU countries should contact their local equipment supplier representative or service center for information about the waste collection system in their country.

16.2.4 PTP 54500 Radio System Specifications

Table 31 contains radio system specifications for the PTP 54500.

Table 31 - PTP 54500 RF Specifications

Radio Technology	Specification
RF Band	5.470-5.725 GHz
Channel Selection	By intelligent Dynamic Frequency Selection (i-DFS) or manual intervention. Automatic detection on start-up and continual adaptation to avoid interference.
Channel size	5, 10 and 15 MHz
Transmit Power	Varies with modulation mode and settings from -18 dBm to 27 dBm.
Modulation	Dynamic; adapting between BPSK single and 64 QAM.
Receiver Noise Figure	Typically 6 dB
Antenna Type	Integrated: Flat plate antenna. Connectorized: Approved to operate with a selection of separately-purchased single and dual polar antennas through 2xN-type connectors (check local regulations prior to purchase).
Antenna Gain	23 dBi typical
Antenna Beamwidth	8 Degrees
Receiver Sensitivity	Adaptive, varying between -94 dBm and -69 dBm.
Duplex Scheme	Symmetric fixed, asymmetric fixed or adaptive TDD; same frequency Tx/Rx.
Range	155 miles (250 km)
Security and Encryption	Proprietary scrambling mechanism. Optional FIPS-197 compliant 128- and 256-bit AES Encryption.
Weather Sensitivity	Sensitivity at higher modes may be reduced during high winds through trees due to Adaptive Modulation Threshold changes.
Error Correction	FEC

16.2.5 PTP 54500 Emissions and Radio Certifications

Table 32 lists the EMC emissions specifications under which the PTP 54500 has received type approval. Table 33 lists the radio specifications under which the PTP 54500 has received type approval.

Table 32 - PTP 54500 EMC Emissions Compliance

Region	Specification (Type Approvals)
USA	FCC Part 15 Class B
Canada	CSA Std C108.8, 1993 Class B
Europe	EN55022 CISPR 22

Table 33 - PTP 54500 Radio Certifications

Region	Specification (Type Approvals)
USA	FCC Part 15 E
Canada	RSS 210 Issue 7, Annex 9
Europe	EN301 893 V1.4.1 plus changes mandated by the European Commission.

16.2.6 PTP 54500 Available Spectrum Settings

The available spectrum settings for the PTP 54500 are illustrated in this section.

Figure 125, Figure 126 and Figure 127 show the available spectrum settings for the 15 MHz, 10 MHz and 5 MHz channel bandwidths. The PTP 54500 variant operates on a 5 MHz channel raster.

The PTP 54500 product variant does not apply any band edge power reduction.

NOTE

All channel centre frequencies may not be available for all Region Codes.

Figure 125 - PTP 54500 Available Spectrum Settings - 15 MHz Channel Bandwidth

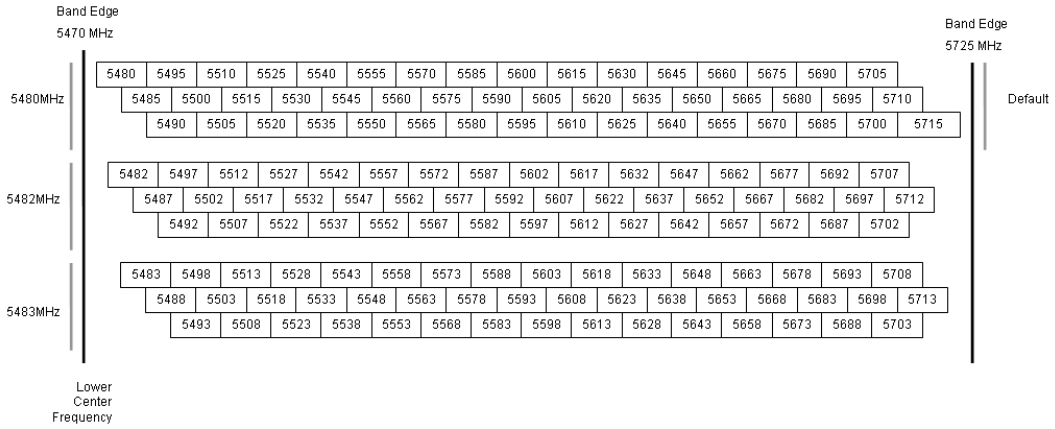


Figure 126 - PTP 54500 Available Spectrum Settings - 10 MHz Channel Bandwidth

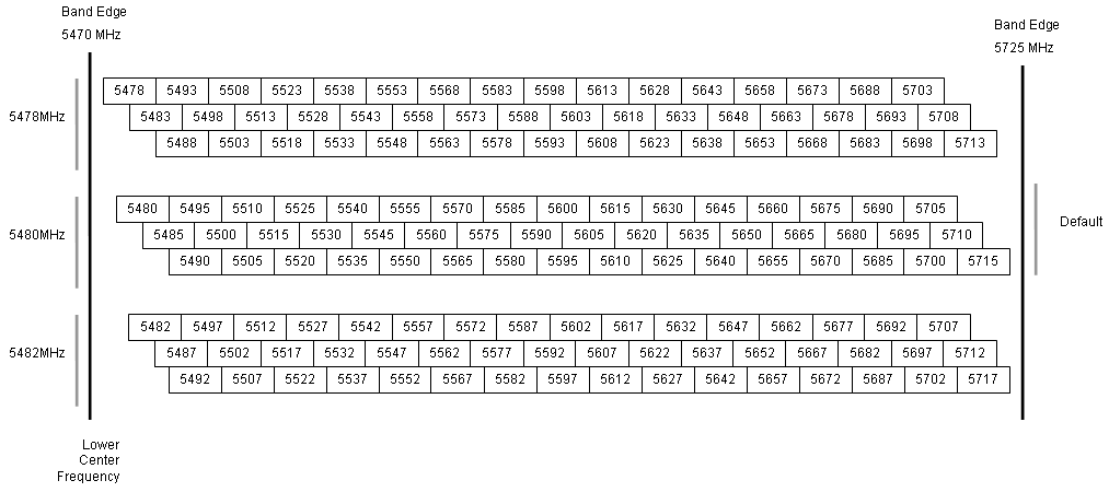
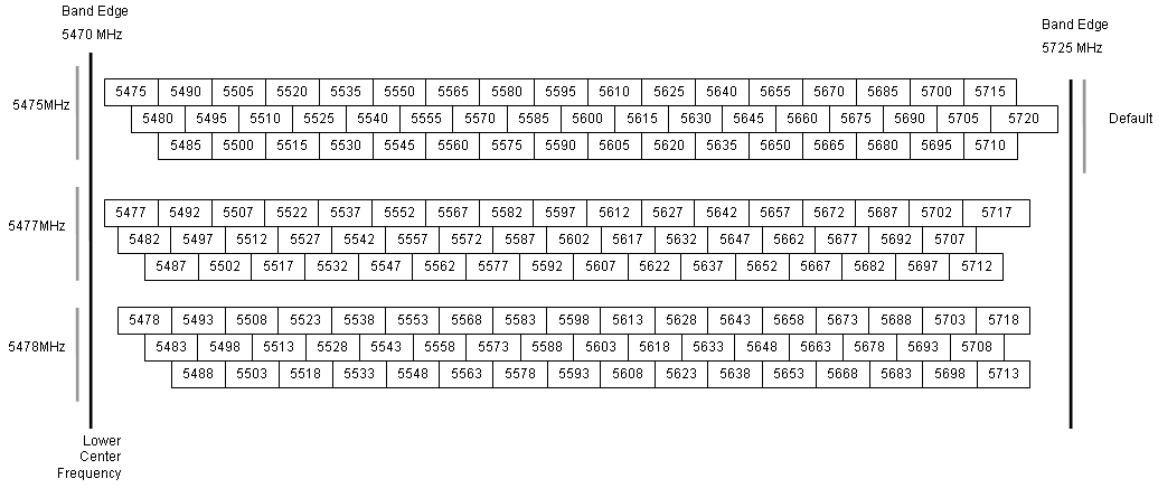


Figure 127 - PTP 54500 Available Spectrum Settings - 5 MHz Channel Bandwidth



16.2.7 PTP 54500 System Threshold, Output Power and Link Loss

PTP 54500 system threshold, output power and maximum link loss are given in the following tables:

- Table 34 - IP Mode (15 MHz bandwidth).
- Table 35 - TDM Mode (15 MHz bandwidth).
- Table 36 - IP Mode (10 MHz bandwidth).
- Table 37- TDM Mode (10 MHz bandwidth).
- Table 38 - IP Mode (5 MHz bandwidth).
- Table 39 - TDM Mode (5 MHz bandwidth).

These figures assume that antenna gain is 23 dBi.

Table 34 - PTP 54500 System Threshold Figures - IP Mode (15 MHz bandwidth)

Modulation Mode	System Threshold (dBm)	Vector Error (dB)	Output Power (dBm)	Max Link Loss (dB)
64QAM 0.83 dual	-70.2	-21.1	+21.0	137.2
64QAM 0.67 dual	-74.0	-18.8	+22.0	142.0
16QAM 0.75 dual	-76.7	-14.7	+23.0	145.6
16QAM 0.50 dual	-81.2	-12.1	+24.0	151.2
QPSK 0.75 dual	-82.6	-8.3	+25.0	153.6
64QAM 0.83 single	-73.6	-21.1	+21.0	140.5
64QAM 0.67 single	-77.0	-18.8	+22.0	145.0
16QAM 0.75 single	-79.9	-14.7	+23.0	148.9
16QAM 0.50 single	-84.8	-12.0	+24.0	154.8
QPSK 0.75 single	-86.4	-8.2	+25.0	157.4
QPSK 0.50 single	-88.8	-6.5	+26.0	160.8
BPSK 0.50 single	-94.1	-1.9	+27.0	167.1

Table 35 - PTP 54500 System Threshold Figures - TDM Mode (15 MHz bandwidth)

Modulation Mode	System Threshold (dBm)	Vector Error (dB)	Output Power (dBm)	Max Link Loss (dB)
64QAM 0.83 dual	-65.9	-24.2	+21.0	132.9
64QAM 0.67 dual	-69.3	-21.9	+22.0	137.3
16QAM 0.75 dual	-73.6	-17.8	+23.0	142.6
16QAM 0.50 dual	-76.3	-15.1	+24.0	146.3
QPSK 0.75 dual	-79.1	-11.5	+25.0	150.1
64QAM 0.83 single	-69.7	-24.2	+21.0	136.7
64QAM 0.67 single	-72.5	-22.0	+22.0	140.5
16QAM 0.75 single	-76.5	-17.8	+23.0	145.5
16QAM 0.50 single	-79.3	-15.1	+24.0	149.3
QPSK 0.75 single	-82.5	-11.5	+25.0	153.5
QPSK 0.50 single	-84.9	-9.7	+26.0	156.9
BPSK 0.50 single	-94.1	-1.9	+27.0	167.1

Table 36 - PTP 54500 System Threshold Figures - IP Mode (10 MHz bandwidth)

Modulation Mode	System Threshold (dBm)	Vector Error (dB)	Output Power (dBm)	Max Link Loss (dB)
64QAM 0.83 dual	-72.7	-21.1	+21.0	139.7
64QAM 0.67 dual	-76.2	-18.8	+22.0	144.2
16QAM 0.75 dual	-79.2	-14.7	+23.0	148.2
16QAM 0.50 dual	-83.8	-12.1	+24.0	153.8
QPSK 0.75 dual	-84.7	-8.5	+25.0	155.7
64QAM 0.83 single	-75.2	-21.1	+21.0	142.2
64QAM 0.67 single	-78.7	-18.8	+22.0	146.7
16QAM 0.75 single	-81.8	-14.7	+23.0	150.7
16QAM 0.50 single	-86.8	-12.0	+24.0	156.8
QPSK 0.75 single	-88.5	-8.1	+25.0	159.5
QPSK 0.50 single	-90.7	-6.5	+26.0	162.7
BPSK 0.50 single	-95.5	-2.0	+27.0	168.5

Table 37 - PTP 54500 System Threshold Figures - TDM Mode (10 MHz bandwidth)

Modulation Mode	System Threshold (dBm)	Vector Error (dB)	Output Power (dBm)	Max Link Loss (dB)
64QAM 0.83 dual	-67.4	-24.2	+21.0	134.4
64QAM 0.67 dual	-70.8	-21.9	+22.0	138.8
16QAM 0.75 dual	-75.0	-17.8	+23.0	144.0
16QAM 0.50 dual	-77.8	-15.1	+24.0	147.8
QPSK 0.75 dual	-80.7	-11.6	+25.0	151.7
64QAM 0.83 single	-71.2	-24.2	+21.0	138.2
64QAM 0.67 single	-73.9	-22.0	+22.0	141.9
16QAM 0.75 single	-78.0	-17.8	+23.0	147.0
16QAM 0.50 single	-81.0	-15.1	+24.0	151.0
QPSK 0.75 single	-84.7	-11.2	+25.0	155.7
QPSK 0.50 single	-86.6	-9.7	+26.0	158.6
BPSK 0.50 single	-95.5	-2.0	+27.0	168.5

Table 38 - PTP 54500 System Threshold Figures - IP Mode (5 MHz bandwidth)

Modulation Mode	System Threshold (dBm)	Vector Error (dB)	Output Power (dBm)	Max Link Loss (dB)
64QAM 0.83 dual	-74.8	-21.1	+21.0	141.8
64QAM 0.67 dual	-78.3	-18.8	+22.0	146.3
16QAM 0.75 dual	-81.4	-14.7	+23.0	150.4
16QAM 0.50 dual	-86.4	-12.1	+24.0	156.4
QPSK 0.75 dual	-87.3	-8.7	+25.0	158.3
64QAM 0.83 single	-77.7	-21.2	+21.0	144.7
64QAM 0.67 single	-81.5	-18.8	+22.0	149.5
16QAM 0.75 single	-84.8	-14.7	+23.0	153.8
16QAM 0.50 single	-88.8	-12.2	+24.0	158.8
QPSK 0.75 single	-90.4	-9.0	+25.0	161.4
QPSK 0.50 single	-92.3	-7.5	+26.0	164.3
BPSK 0.50 single	-99.0	-1.9	+27.0	172.0

Table 39 - PTP 54500 System Threshold Figures - TDM Mode (5 MHz bandwidth)

Modulation Mode	System Threshold (dBm)	Vector Error (dB)	Output Power (dBm)	Max Link Loss (dB)
64QAM 0.83 dual	-70.4	-24.2	+21.0	137.4
64QAM 0.67 dual	-73.4	-22.0	+22.0	141.4
16QAM 0.75 dual	-77.5	-17.8	+23.0	146.5
16QAM 0.50 dual	-80.5	-15.1	+24.0	150.5
QPSK 0.75 dual	-83.8	-11.4	+25.0	154.8
64QAM 0.83 single	-74.0	-24.2	+21.0	141.0
64QAM 0.67 single	-76.5	-22.0	+22.0	144.5
16QAM 0.75 single	-80.8	-17.8	+23.0	149.8
16QAM 0.50 single	-84.1	-15.2	+24.0	154.1
QPSK 0.75 single	-87.8	-11.1	+25.0	158.8
QPSK 0.50 single	-89.7	-9.5	+26.0	161.7
BPSK 0.50 single	-99.0	-1.9	+27.0	172.0

16.2.8 PTP 54500 FCC Antenna Restrictions

In FCC regions, external antennas from the list in Table 40 can be used with the Connectorized version of the PTP 54500. These are approved by the FCC for use with the product and are constrained by the following limit for Single/Dual Polarization Parabolic Dish Antennas: up to 34.6 dBi per polarization or antenna.

However, the Maximum Transmit Power must be reduced to avoid exceeding the EIRP limits.

In FCC regions when using external antennas, cable loss between the connectorized version of the PTP 500 Series Bridge and the antenna ports must not be less than 1.2 dB.

⚠ CAUTION

Antennas not included in this table, or those having a gain greater than the specified maximum, are strictly prohibited for use with the PTP 54500. The required antenna impedance is 50 ohms.

Table 40 - Allowed Antennas for Deployment in USA/Canada – 5.4 GHz

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
Andrew	Andrew 2-foot Parabolic, P2F-52 (29.4 dBi)	29.4	Y
Andrew	Andrew 2-foot Dual-Pol Parabolic, PX2F-52 (29.4 dBi)	29.4	Y
Andrew	Andrew 3-foot Parabolic, P3F-52 (33.4 dBi)	33.4	Y
Andrew	Andrew 3-foot Dual-Pol Parabolic, PX3F-52 (33.4 dBi)	33.4	Y
Andrew	Andrew 4-foot Parabolic, P4F-52 (34.9 dBi)	34.9	Y
Andrew	Andrew 4-foot Dual-Pol Parabolic, PX4F-52 (34.9 dBi)	34.9	Y
Gabriel	Gabriel 2-foot High Performance QuickFire Parabolic, HQF2-52-N	28.2	Y
Gabriel	Gabriel 4-foot High Performance QuickFire Parabolic, HQF4-52-N	34.4	Y
Gabriel	Gabriel 2-foot High Performance Dual QuickFire Parabolic, HQFD2-52-N	28.1	Y
Gabriel	Gabriel 4-foot High Performance Dual QuickFire Parabolic, HQFD4-52-N	34.3	Y

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N	28.5	Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N-RK	28.5	Y
Gabriel	Gabriel 2.5-foot Standard QuickFire Parabolic, QF2.5-52-N	31.2	Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N	34.8	Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N-RK	34.8	Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N	28.4	Y
Gabriel	Gabriel 2.5-foot Standard Dual QuickFire Parabolic, QFD2.5-52-N	31.1	Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N-RK	28.4	Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N	34.7	Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N-RK	34.7	Y
RadioWaves	Radio Waves 2-foot Dual-Pol Parabolic, SPD2-5.2 (28.1 dBi)	28.1	Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-5.2 (29.0 dBi)	29	Y
RadioWaves	Radio Waves 3-foot Dual-Pol Parabolic, SPD3-5.2 (31.1 dBi)	31.1	Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-5.2 (31.4 dBi)	31.4	Y
RadioWaves	Radio Waves 4-foot Dual-Pol Parabolic, SPD4-5.2 (34.4 dBi)	34.4	Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-5.2 (34.8 dBi)	34.8	Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-2/5 (28.3 dBi)	28.3	Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-2/5 (31.4 dBi)	31.4	Y

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
RadioWaves	Radio Waves 4-foot Parabolic, SP4-2/5 (34.6 dBi)	34.6	Y
RFS	RFS 2-foot Parabolic, SPF2-52AN or SPFX2-52AN (27.9 dBi)	27.9	Y
RFS	RFS 3-foot Parabolic, SPF3-52AN or SPFX3-52AN(31.4 dBi)	31.4	Y
RFS	RFS 4-foot Parabolic, SPF4-52AN or SPFX4-52AN(33.9 dBi)	33.9	Y
RFS	RFS 2-foot HP Parabolic, SDF2-52AN or SDFX2-52AN (31.4 dBi)	31.4	Y
RFS	RFS 4-foot HP Parabolic, SDF4-52AN or SDFX4-52AN (33.9 dBi)	33.9	Y

16.3 PTP 58500 Reference Information

This section contains reference information that is specific to the PTP 58500 frequency variant.

16.3.1 PTP 58500 Examples of Regulatory Limits

Table 41 shows how the regulatory limits currently apply in specific countries. Operators should note that regulations are subject to change.

Table 41 – PTP 58500 Examples of Regulatory Limits

	Examples of Regulatory Limits
USA/ Canada/ Taiwan	Equipment can be operated in any mode, best results will be obtained using Region 1 settings. There are some limitations on the use of antennas above 4ft diameter plus a 1 dB band edge power reduction.
UK	Under UK Regulations, operation of this product is allowed with a License Key for Region 4 . This implements Radar Detection with barring of the band from 5795 MHz to 5815 MHz and above 5850 MHz. It limits the EIRP to the Regulatory Limits below: EIRP ≤ Max of [(23 +10 x Log(Channel BW)) and 36] dBm
Eire	Under Eire Regulations, operation of this product is only allowed with a License Key for Region 6. This limits the EIRP to the Regulatory Limits below: EIRP ≤ Max of [(20 +10 x Log(Channel BW)) and 33] dBm
Norway	Under Norway Regulations, operation of this product is only allowed with a License Key for Region 7. This implements Radar Detection and limits the EIRP to the Regulatory Limits below: EIRP ≤ Max of [(40 +10 x Log(Channel BW)) and 53] dBm
Germany	Operation of this product is only allowed with a License Key for Region 22. This limits the band of operation to 5755 MHz to 5875 MHz and limits the EIRP to the Regulatory Limits below: EIRP ≤ Max of [(23 +10 x Log(Channel BW)) and 36] dBm
Denmark	Operation of this product is only allowed with a License Key for Region 27. This implements Radar Detection with barring of the band from 5795 MHz to 5815 MHz. It limits the EIRP to the Regulatory Limits below: EIRP ≤ Max of [(23 +10 x Log(Channel BW)) and 36] dBm

General Notice Applicable to Europe
This equipment complies with the essential requirements for the EU R&E Directive 1999/5/EC.
The use of 5.8 GHz for Point to Point radio links is not harmonized across the EU.
However, the regulatory situation in Europe is changing and the radio spectrum may become available in other countries in the near future. Please contact Motorola for the latest situation.

CE ! 1321 DK, DE, IE, NO, UK

16.3.2 PTP 58500 Licenses and Region Codes

PTP 58500 units may be operated in any of the regions listed in Table 42.

PTP 58500 units are configured with a license key for Region Code 1. An alternative license key is provided in the Deployment Guide for Region Code 25. For any other permitted region, obtain a new license key from the reseller or distributor.

Table 42 – PTP 58500 Licenses and Region Codes

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
1	FCC USA, Canada, Taiwan, Brazil	5725 - 5850 MHz		5, 10, 15 MHz	27 dBm	Reduced TX power at band edges.
2	China	5725 - 5850 MHz		5, 10, 15 MHz	33 dBm EIRP	
3	Australia, Hong Kong	5725 - 5850 MHz		5, 10, 15 MHz	36 dBm EIRP	
4	UK	5725 - 5795 MHz 5815 - 5850 MHz	Yes	5 MHz	29 dBm EIRP	5795 MHz to 5815 MHz is assigned for Road Transport and Traffic Telematics (RTTT).
				10 MHz	32 dBm EIRP	
				15 MHz	34 dBm EIRP	
5	Singapore	5725 - 5850 MHz		5, 10, 15 MHz	20 dBm EIRP	
6	Eire	5725 - 5875 MHz		5 MHz	27 dBm EIRP	
				10 MHz	30 dBm EIRP	
				15 MHz	31 dBm EIRP	
7	Norway	5725 - 5795 MHz 5815 - 5850 MHz	Yes	5 MHz	47 dBm EIRP	
				10 MHz	50 dBm EIRP	
				15 MHz	51 dBm EIRP	
8	Full Power	5725 - 5875 MHz		5, 10, 15 MHz	27 dBm	
19	India	5825 - 5875 MHz		5 MHz	33 dBm EIRP	
				10 MHz	36 dBm EIRP	
				15 MHz	36 dBm EIRP	

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
20	Thailand	5725 - 5850 MHz		5, 10, 15 MHz	30 dBm EIRP	
22	Germany	5755 - 5875 MHz	Yes	5 MHz	29 dBm EIRP	
				10 MHz	32 dBm EIRP	
				15 MHz	34 dBm EIRP	
24	Bahrain	5725 - 5850 MHz	Yes	5 MHz	27 dBm EIRP	
				10 MHz	30 dBm EIRP	
				15 MHz	31 dBm EIRP	
25	ETSI	5725 - 5875 MHz	Yes	5 MHz	29 dBm EIRP	
				10 MHz	32 dBm EIRP	
				15 MHz	34 dBm EIRP	
27	Denmark	5725 - 5795 5815 - 5875 MHz	Yes	5 MHz	29 dBm EIRP	5795 MHz to 5815 MHz is assigned for Road Transport and Traffic Telematics (RTTT)
				10 MHz	32 dBm EIRP	
				15 MHz	34 dBm EIRP	

16.3.3 PTP 58500 Regulatory Compliance

The PTP 58500 complies with the regulations that are in force in the USA, Canada and Europe. The relevant notifications are specified in this section.

⚠ CAUTION

This equipment operates as a secondary application, so it has no rights against harmful interference, even if generated by similar equipment, and must not cause harmful interference on systems operating as primary applications.

16.3.3.1 PTP 58500 FCC and IC Notification

U.S. Federal Communication Commission (FCC) and Industry Canada (IC) Notification.

This system has achieved Type Approval in various countries around the world. This means that the system has been tested against various local technical regulations and found to comply. The frequency band in which the system operates is 'license exempt' and the system is allowed to be used provided it does not cause interference. Further, the licensing authority does not guaranteed protection against interference from other products and installations.

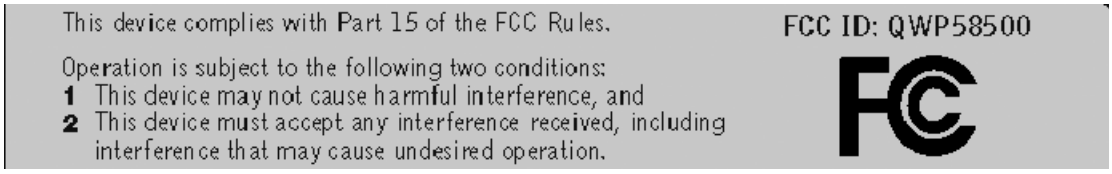
This device complies with part 15 of the US FCC Rules and Regulations and with RSS-210 of Industry Canada. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation. In Canada, users should be cautioned to take note that high power radars are allocated as primary users (meaning they have priority) of the 5650 – 5850 MHz spectrum and these radars could cause interference and/or damage to license-exempt local area networks (LELAN).

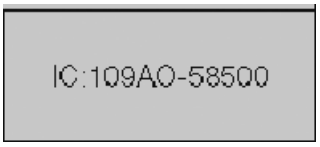
For the connectorized version of the product and in order to reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the Effective Isotropically Radiated Power (EIRP) is not more than that permitted for successful communication.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US FCC Rules and with RSS-210 of Industry Canada. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

FCC IDs and Industry Canada Certification Numbers are listed below:





Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply.

16.3.3.2 PTP 58500 European Union Notification

The PTP 58500 connectorized product is a two-way radio transceiver suitable for use in Broadband Wireless Access System (BWAS), Radio Local Area Network (RLAN), or Fixed Wireless Access (FWA) systems. It is a Class 2 device and uses operating frequencies that are not harmonized throughout the EU member states. The operator is responsible for obtaining any national licenses required to operate this product and these must be obtained before using the product in any particular country.

The use of 5.8 GHz for Point to Point radio links is not harmonized across the EU and currently the product may only be deployed in the UK, Eire (IRL), Germany, Norway and Denmark. However, the regulatory situation in Europe is changing and the radio spectrum may become available in other countries in the near future. Also see www.ero.dk for further information.

NOTE

Norway regulation is FOR2007-04-20 Nr 439 regarding border PFD limit.

Motorola declares that the PTP 58500 product complies with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity may be consulted at http://motorola.canopywireless.com/doc.php.

This equipment is marked to show compliance with the European R&TTE directive 1999/5/EC.

CE ! 1321 DK, DE, IE, NO, UK



European Union (EU) Waste of Electrical and Electronic Equipment (WEEE) directive

The European Union's WEEE directive requires that products sold into EU countries must have the crossed out trash bin label on the product (or the package in some cases). As defined by the WEEE directive, this cross-out trash bin label means that customers and end-users in EU countries should not dispose of electronic and electrical equipment or accessories in household waste. Customers or end-users in EU countries should contact their local equipment supplier representative or service center for information about the waste collection system in their country.

16.3.3.3 UK Notification

The PTP 58500 connectorized product has been notified for operation in the UK, and when operated in accordance with instructions for use it is compliant with UK Interface Requirement IR2007. For UK use, installations must conform to the requirements of IR2007 in terms of EIRP spectral density against elevation profile above the local horizon in order to protect Fixed Satellite Services. The frequency range 5795-5815 MHz is assigned to Road Transport & Traffic Telematics (RTTT) in the U.K. and shall not be used by FWA systems in order to protect RTTT devices. UK Interface Requirement IR2007 specifies that radiolocation services shall be protected by a Dynamic Frequency Selection (DFS) mechanism to prevent co-channel operation in the presence of radar signals.

16.3.4 PTP 58500 Radio System Specifications

Table 43 contains radio system specifications for the PTP 58500.

Table 43 - PTP 58500 RF Specifications

Radio Technology	Specification
RF Band	5.725-5.875 GHz
Channel Selection	By intelligent Dynamic Frequency Selection (i-DFS) or manual intervention Automatic detection on start-up and continual adaptation to avoid interference.
Channel size	5, 10 and 15 MHz
Transmit Power	Varies with modulation mode and settings from -18 dBm to 27 dBm.
Modulation	Dynamic; adapting between BPSK single and 64 QAM.
Receiver Noise Figure	Typically 6 dB
Antenna Type	Integrated: Flat plate antenna. Connectorized: Approved to operate with a selection of separately-purchased single and dual polar antennas through 2xN-type connectors (check local regulations prior to purchase).
Antenna Gain	23 dBi typical
Antenna Beamwidth	8 Degrees
Receiver Sensitivity	Adaptive, varying between -94 dBm and -69 dBm.
Duplex Scheme	Symmetric fixed, asymmetric fixed or adaptive TDD; same or split frequency Tx/Rx where regulations permit.
Range	155 miles (250 km)
Security and Encryption	Proprietary scrambling mechanism. Optional FIPS-197 compliant 128- and 256-bit AES Encryption.
Weather Sensitivity	Sensitivity at higher modes may be reduced during high winds through trees due to Adaptive Modulation Threshold changes
Error Correction	FEC

16.3.5 PTP 58500 Emissions and Radio Certifications

Table 44 lists the EMC emissions specifications under which the PTP 58500 has received type approval. Table 45 lists the radio specifications under which the PTP 58500 has received type approval.

Table 44 - PTP 58500 EMC Emissions Compliance

Region	Specification (Type Approvals)
USA	CFR 47 Part 15 Class B
Canada	CSA Std C108.8, 1993 Class B
Europe	EN55022 CISPR 22

Table 45 - PTP 58500 Radio Certifications

Region	Specification (Type Approvals)
USA	FCC Part 15.247
CANADA	RSS 210 Issue 7, Annex 8
UK	IR 2007
Eire	ComReg 02/71R1
Germany	Order No 47/2007
EU	EN302 502 v 1.2.1

16.3.6 PTP 58500 Available Spectrum Settings

The available spectrum settings for the PTP 58500 are illustrated in this section.

Figure 128, Figure 129 and Figure 130 show the available spectrum settings for the 15 MHz, 10 MHz and 5 MHz channel bandwidths in those regions where the band edge is 5850 MHz (for example FCC). The PTP 58500 variant operates on a 5 MHz channel raster.

NOTE

All channel centre frequencies may not be available for all Region Codes.

Figure 128 – PTP 58500 Available Spectrum Settings – 15 MHz Channel Bandwidth

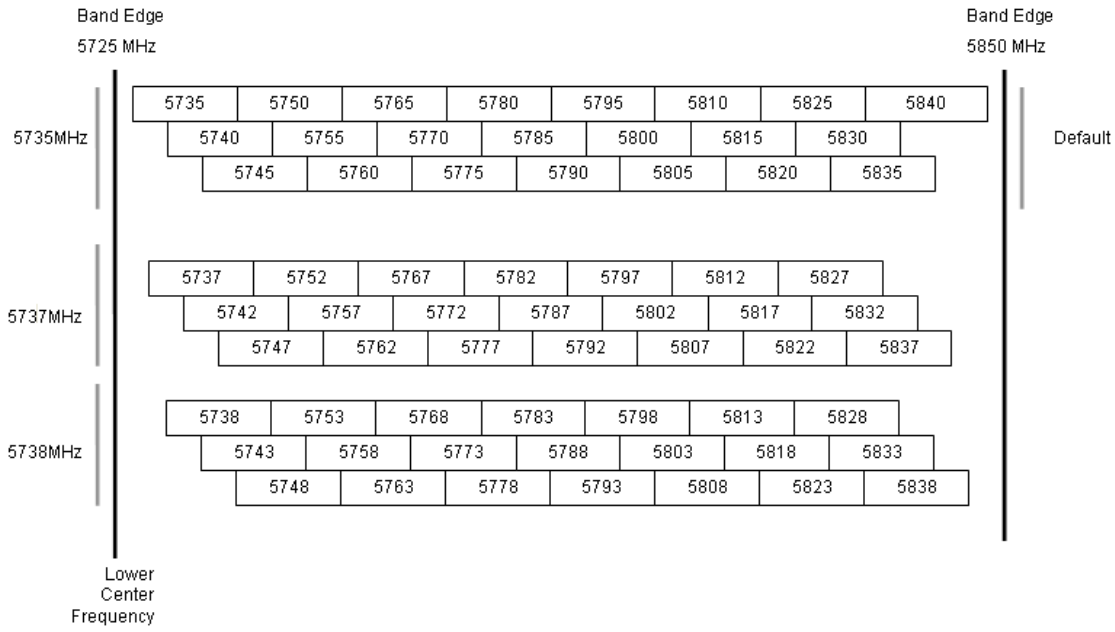


Figure 129 – PTP 58500 Available Spectrum Settings – 10 MHz Channel Bandwidth

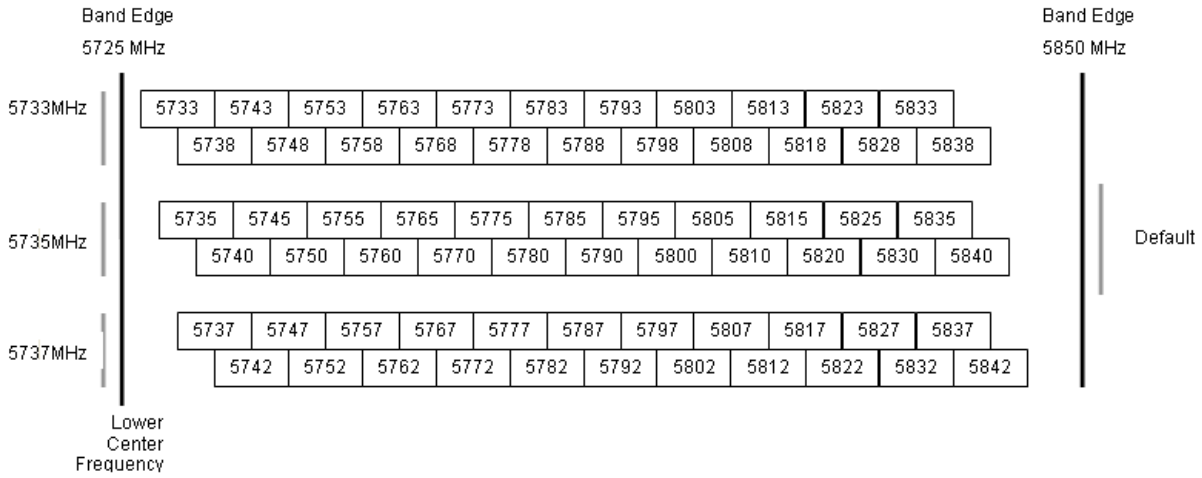
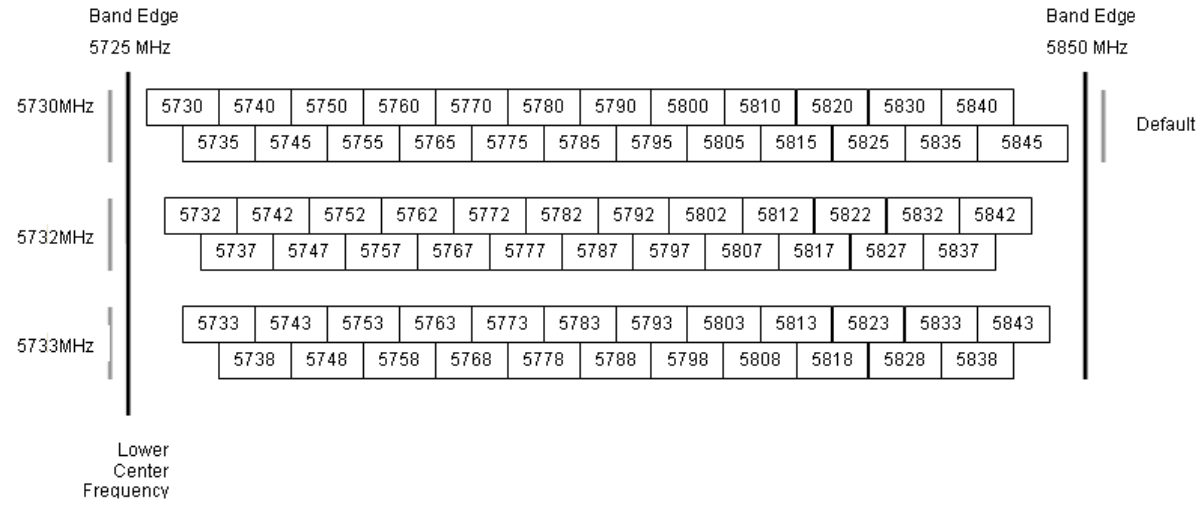


Figure 130 – PTP 58500 Available Spectrum Settings – 5 MHz Channel Bandwidth



16.3.6.1 PTP 58500 Transmit Power Reduction at the Band Edges

Operation at or near the 5.8 GHz band edges can results in a lower maximum transmit power. In some configurations the PTP 500 Series Bridge solution reduces the power when operating at the edge channels. The amount of reduction, if any, is dependant on the region code of the region of operation. This currently only affects systems configured for Region Code 1. The maximum powers at the edge channels for 5 MHz, 10 MHz and 15 MHz are presented in Table 46 (FCC).

Table 46 – PTP 58500 FCC Max Transmit Power at the Edge Channels (FCC)

Channel Frequency (MHz)	Max Power (dBm) 5 MHz Bandwidth	Max Power (dBm) 10 MHz Bandwidth	Max Power (dBm) 15 MHz Bandwidth
5730	26	N/A	N/A
5731	27	N/A	N/A
5732	27	N/A	N/A
5733	27	26	N/A
5734	27	27	N/A
5735	27	27	25
5736	27	27	25
5737	27	27	25
5738	27	27	25
5739	27	27	25
5740 - 5838	27	27	27
5839	27	27	26
5840	27	27	26
5841	27	27	N/A
5842	27	26	N/A
5843	27	N/A	N/A
5844	27	N/A	N/A
5845	26	N/A	N/A

16.3.7 PTP 58500 System Threshold, Output Power and Link Loss

PTP 58500 system threshold figures are given in the following tables:

- Table 47 - IP Mode (15 MHz bandwidth).
- Table 48 - TDM Mode (15 MHz bandwidth).
- Table 49 - IP Mode (10 MHz bandwidth).
- Table 50 - TDM Mode (10 MHz bandwidth).
- Table 51 - IP Mode (5 MHz bandwidth).
- Table 52 - TDM Mode (5 MHz bandwidth).

These figures assume that antenna gain is 23 dBi.

Table 47 - PTP 58500 System Threshold Figures - IP Mode (15 MHz bandwidth)

Modulation Mode	System Threshold (dBm)	Vector Error (dB)	Output Power (dBm)	Max Link Loss (dB)
64QAM 0.83 dual	-70.2	-21.1	+21.0	137.2
64QAM 0.67 dual	-74.0	-18.8	+22.0	142.0
16QAM 0.75 dual	-76.7	-14.7	+23.0	145.7
16QAM 0.50 dual	-81.3	-12.1	+24.0	151.3
QPSK 0.75 dual	-82.6	-8.4	+25.0	153.6
64QAM 0.83 single	-73.7	-21.1	+21.0	140.7
64QAM 0.67 single	-77.1	-18.8	+22.0	145.1
16QAM 0.75 single	-79.9	-14.7	+23.0	148.9
16QAM 0.50 single	-84.9	-12.0	+24.0	154.9
QPSK 0.75 single	-86.5	-8.2	+25.0	157.4
QPSK 0.50 single	-89.0	-6.4	+26.0	161.0
BPSK 0.50 single	-94.4	-2.0	+27.0	167.4

Table 48 - PTP 58500 System Threshold Figures - TDM Mode (15 MHz bandwidth)

Modulation Mode	System Threshold (dBm)	Vector Error (dB)	Output Power (dBm)	Max Link Loss (dB)
64QAM 0.83 dual	-66.4	-24.1	+21.0	133.4
64QAM 0.67 dual	-69.6	-21.9	+22.0	137.6
16QAM 0.75 dual	-73.7	-17.8	+23.0	142.7
16QAM 0.50 dual	-76.3	-15.1	+24.0	146.3
QPSK 0.75 dual	-79.8	-11.5	+25.0	150.2
64QAM 0.83 single	-69.9	-24.2	+21.0	136.9
64QAM 0.67 single	-72.6	-22.0	+22.0	140.6
16QAM 0.75 single	-76.5	-17.8	+23.0	145.5
16QAM 0.50 single	-79.3	-15.1	+24.0	149.3
QPSK 0.75 single	-82.9	-11.2	+25.0	153.9
QPSK 0.50 single	-85.0	-9.6	+26.0	157.0
BPSK 0.50 single	-94.4	-2.0	+27.0	167.4

Table 49 - PTP 58500 System Threshold Figures - IP Mode (10 MHz bandwidth)

Modulation Mode	System Threshold (dBm)	Vector Error (dB)	Output Power (dBm)	Max Link Loss (dB)
64QAM 0.83 dual	-72.8	-21.1	+21.0	139.8
64QAM 0.67 dual	-76.2	-18.7	+22.0	144.2
16QAM 0.75 dual	-79.2	-14.7	+23.0	148.2
16QAM 0.50 dual	-83.7	-12.1	+24.0	153.7
QPSK 0.75 dual	-84.7	-8.5	+25.0	155.7
64QAM 0.83 single	-75.3	-21.2	+21.0	142.3
64QAM 0.67 single	-78.8	-18.7	+22.0	146.8
16QAM 0.75 single	-81.8	-14.7	+23.0	150.8
16QAM 0.50 single	-86.8	-12.1	+24.0	156.8
QPSK 0.75 single	-88.5	-8.1	+25.0	159.5
QPSK 0.50 single	-90.7	-6.5	+26.0	162.7
BPSK 0.50 single	-96.4	-2.0	+27.0	169.4

Table 50 - PTP 58500 System Threshold Figures - TDM Mode (10 MHz bandwidth)

Modulation Mode	System Threshold (dBm)	Vector Error (dB)	Output Power (dBm)	Max Link Loss (dB)
64QAM 0.83 dual	-68.0	-24.1	+21.0	135.0
64QAM 0.67 dual	-71.0	-21.9	+22.0	139.0
16QAM 0.75 dual	-75.0	-17.8	+23.0	144.0
16QAM 0.50 dual	-77.8	-15.1	+24.0	147.8
QPSK 0.75 dual	-80.7	-11.6	+25.0	151.7
64QAM 0.83 single	-71.7	-24.2	+21.0	138.7
64QAM 0.67 single	-74.1	-22.0	+22.0	142.1
16QAM 0.75 single	-78.1	-17.8	+23.0	147.1
16QAM 0.50 single	-81.0	-15.1	+24.0	151.0
QPSK 0.75 single	-84.8	-11.2	+25.0	155.7
QPSK 0.50 single	-86.6	-9.7	+26.0	158.6
BPSK 0.50 single	-96.4	-2.0	+27.0	169.4

Table 51 - PTP 58500 System Threshold Figures - IP Mode (5 MHz bandwidth)

Modulation Mode	System Threshold (dBm)	Vector Error (dB)	Output Power (dBm)	Max Link Loss (dB)
64QAM 0.83 dual	-75.0	-21.1	+21.0	142.0
64QAM 0.67 dual	-78.5	-18.8	+22.0	146.5
16QAM 0.75 dual	-81.5	-14.7	+23.0	150.5
16QAM 0.50 dual	-86.5	-12.1	+24.0	156.5
QPSK 0.75 dual	-87.3	-8.8	+25.0	158.3
64QAM 0.83 single	-77.9	-21.2	+21.0	144.9
64QAM 0.67 single	-81.7	-18.8	+22.0	149.6
16QAM 0.75 single	-84.9	-14.7	+23.0	153.9
16QAM 0.50 single	-88.7	-12.2	+24.0	158.7
QPSK 0.75 single	-90.5	-9.0	+25.0	161.4
QPSK 0.50 single	-92.4	-7.5	+26.0	164.4
BPSK 0.50 single	-99.0	-1.9	+27.0	172.0

Table 52 - PTP 58500 System Threshold Figures - TDM Mode (5 MHz bandwidth)

Modulation Mode	System Threshold (dBm)	Vector Error (dB)	Output Power (dBm)	Max Link Loss (dB)
64QAM 0.83 dual	-71.0	-24.1	+21.0	138.0
64QAM 0.67 dual	-73.6	-22.0	+22.0	141.6
16QAM 0.75 dual	-77.7	-17.8	+23.0	146.7
16QAM 0.50 dual	-80.6	-15.1	+24.0	150.6
QPSK 0.75 dual	-83.9	-11.4	+25.0	154.9
64QAM 0.83 single	-74.4	-24.2	+21.0	141.4
64QAM 0.67 single	-76.7	-22.0	+22.0	144.7
16QAM 0.75 single	-81.0	-17.8	+23.0	150.0
16QAM 0.50 single	-84.8	-14.5	+24.0	154.8
QPSK 0.75 single	-88.0	-11.0	+25.0	159.0
QPSK 0.50 single	-89.8	-9.5	+26.0	161.8
BPSK 0.50 single	-99.0	-1.9	+27.0	172.0

16.3.8 PTP 58500 FCC Antenna Restrictions

In FCC regions, external antennas from the list in Table 53 can be used with the Connectorized version of the PTP 58500. These are approved by the FCC for use with the product and are constrained by the following limit for Single/Dual Polarization Parabolic Dish Antennas: up to 37.7 dBi per polarization or antenna.

In FCC regions when using external antennas, cable loss between the connectorized version of the PTP 500 Series Bridge and the antenna ports must not be less than 1.2 dB.

NOTE

When operating PTP 58500 with a 5 MHz channel bandwidth and with dish antennas larger than 4 ft (1.2 metres) diameter, the maximum operating power must be reduced to 24 dBm (3 dB reduction) to ensure that FCC requirements are met

CAUTION

Antennas not included in this table, or those having a gain greater than the specified maximum, are strictly prohibited for use with the PTP 58500. The required antenna impedance is 50 ohms.

Table 53 - Allowed Antennas for Deployment in USA/Canada – 5.8 GHz

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
Andrew	Andrew 2-foot Parabolic, P2F-52 (29.4 dBi)	29.4		Y
Andrew	Andrew 2-foot Dual-Pol Parabolic, PX2F-52 (29.4 dBi)	29.4		Y
Andrew	Andrew 3-foot Parabolic, P3F-52 (33.4 dBi)	33.4		Y
Andrew	Andrew 3-foot Dual-Pol Parabolic, PX3F-52 (33.4 dBi)	33.4		Y
Andrew	Andrew 4-foot Parabolic, P4F-52 (34.9 dBi)	34.9		Y
Andrew	Andrew 4-foot Dual-Pol Parabolic, PX4F-52 (34.9 dBi)	34.9		Y
Andrew	Andrew 6-foot Parabolic, P6F-52 (37.6 dBi)	37.6		Y
Andrew	Andrew 6-foot Dual-Pol Parabolic, PX6F-52 (37.6 dBi)	37.6		Y
Gabriel	Gabriel 2-foot High Performance QuickFire Parabolic, HQF2-52-N	28.2		Y

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
Gabriel	Gabriel 4-foot High Performance QuickFire Parabolic, HQF4-52-N	34.4		Y
Gabriel	Gabriel 6-foot High Performance QuickFire Parabolic, HQF6-52-N	37.4		Y
Gabriel	Gabriel 2-foot High Performance Dual QuickFire Parabolic, HQFD2-52-N	28.1		Y
Gabriel	Gabriel 4-foot High Performance Dual QuickFire Parabolic, HQFD4-52-N	34.3		Y
Gabriel	Gabriel 6-foot High Performance Dual QuickFire Parabolic, HQFD6-52-N	37.3		Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N	28.5		Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N-RK	28.5		Y
Gabriel	Gabriel 2.5-foot Standard QuickFire Parabolic, QF2.5-52-N	31.2		Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N	34.8		Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N-RK	34.8		Y
Gabriel	Gabriel 6-foot Standard QuickFire Parabolic, QF6-52-N	37.7		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N	28.4		Y
Gabriel	Gabriel 2.5-foot Standard Dual QuickFire Parabolic, QFD2.5-52-N	31.1		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N-RK	28.4		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N	34.7		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N-RK	34.7		Y
Gabriel	Gabriel 6-foot Standard Dual QuickFire Parabolic, QFD6-52-N	37.7		Y
RadioWaves	Radio Waves 2-foot Dual-Pol Parabolic, SPD2-5.2 (28.1 dBi)	28.1		Y

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
RadioWaves	Radio Waves 2-foot Parabolic, SP2-5.2 (29.0 dBi)	29		Y
RadioWaves	Radio Waves 3-foot Dual-Pol Parabolic, SPD3-5.2 (31.1 dBi)	31.1		Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-5.2 (31.4 dBi)	31.4		Y
RadioWaves	Radio Waves 4-foot Dual-Pol Parabolic, SPD4-5.2 (34.4 dBi)	34.4		Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-5.2 (34.8 dBi)	34.8		Y
RadioWaves	Radio Waves 6-foot Dual-Pol Parabolic, SPD6-5.2 (37.5 dBi)	37.5		Y
RadioWaves	Radio Waves 6-foot Parabolic, SP6-5.2 (37.7 dBi)	37.7		Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-2/5 (28.3 dBi)	28.3		Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-2/5 (31.4 dBi)	31.4		Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-2/5 (34.6 dBi)	34.6		Y
RadioWaves	Radio Waves 6-foot Parabolic, SP6-2/5 (37.7 dBi)	37.7		Y
RFS	RFS 2-foot Parabolic, SPF2-52AN or SPFX2-52AN (27.9 dBi)	27.9		Y
RFS	RFS 3-foot Parabolic, SPF3-52AN or SPFX3-52AN(31.4 dBi)	31.4		Y
RFS	RFS 4-foot Parabolic, SPF4-52AN or SPFX4-52AN(33.9 dBi)	33.9		Y
RFS	RFS 6-foot Parabolic, SPF6-52AN or SPFX6-52AN (37.4 dBi)	37.4		Y
RFS	RFS 2-foot HP Parabolic, SDF2-52AN or SDFX2-52AN (31.4 dBi)	31.4		Y
RFS	RFS 4-foot HP Parabolic, SDF4-52AN or SDFX4-52AN (33.9 dBi)	33.9		Y
RFS	RFS 6-foot HP Parabolic, SDF6-52AN or SDFX6-52AN (37.4 dBi)	37.4		Y
StellaDoradus	StellaDoradus 45 inch Parabolic Antenna, 58PSD113	33.8		Y

17 FAQs

Can I source and use my own PoE adaptor with the PTP 500 Series bridge? No. The PTP 500 Series bridge uses a non-standard PoE configuration. Failure to use the Motorola supplied Power Indoor Unit could result in equipment damage and will invalidate the safety certification and may cause a safety hazard.

What is Multiple-Input Multiple-Output (MIMO)? The PTP 500 Series bridge radiates multiple beams from the antenna - the effect of which is to significantly protect against fading and to radically increase the probability that the receiver will decode a usable signal. When the effects of MIMO are combined with those of OFDM techniques and a best in class link budget, there is a significant improvement to the probability of a robust connection over a non-line-of-sight path.

What do you mean by "non-line-of-sight"? A wireless connection between two points without optical line-of-sight, that is, with obstructions between the antennas the transmitted signal is still able to reach the receiver and produce a good quality link.

What else is special about the PTP 500 Series bridge ? There are many special features built-in to the hardware of the PTP 500 Series bridge. The product offers the highest system gain in its class through high sensitivity antennas for improved signal recovery. It also features a radio system that operates on ultra fast digital signal processors but is controlled by firmware giving the ability to download new firmware when enhancements become available. The PTP 500 Series bridge has a built-in web server for advanced management capabilities including detailed radio signal diagnosis.

In which frequency bands does the PTP 500 Series bridge operate? The Motorola PTP 500 Series bridge operates in the unlicensed bands 5.4 GHz (ETSI Band B) and 5.8 GHz (ETSI Band C and FCC ISM band). This means that no license is required to operate the PTP 500 Series bridge.

Why does the PTP 500 Series bridge operate in the 5 GHz band? The 5 GHz band offers the dual benefits of high data throughput and good radio propagation characteristics. The wide band of spectrum available is subdivided into several channels such that multiple systems can operate in the vicinity without causing interference to one another.

Is the PTP 500 Series bridge an 802.11a device? No, although similar, the PTP 500 Series bridge uses different encoding and radio transmission systems from 802.11a. In areas where 802.11a systems are operating, the PTP 500 Series bridge will detect the 802.11a radio signals and choose a clear channel away from any interference.

How much power does the PTP 500 Series bridge transmit? At all times the PTP 500 Series bridge operates within country / region specific regulations for radio power emissions. In addition, the PTP 500 Series bridge uses a technique known as Transmit Power Control (TPC) to ensure that it only transmits sufficient radio power such that the other antenna can receive a high quality signal.

How does the PTP 500 Series Bridge avoid interference from other devices nearby? At initialization, the PTP 500 Series bridge monitors the available frequency channels to find a channel that is clear of interference. In operation PTP 500 Series bridge continuously monitors the spectrum to ensure it is operating on the cleanest channel.

How does the PTP 500 Series bridge integrate into my data network? The PTP 500 Series bridge acts as a transparent bridge between two segments of your network. In this sense, it can be treated like a virtual wired connection between the two buildings. The PTP 500 Series bridge forwards 802.3 Ethernet packets destined for the other part of the network and filters packets it does not need to forward. The system is transparent to higher-level management systems such as VLANs and Spanning Tree.

How does the PTP 500 Series bridge provide security for data traffic? The PTP 500 Series bridge has a range of security features. At installation time each link must be programmed with the serial ID of its partner. The two ends of the link will only communicate with one another, eliminating any chance of "man in the middle" attacks. Over the air security is achieved through a proprietary scrambling mechanism that cannot be disabled, spoofed or snooped by commercial tools.

18 Glossary

ARP	Address Resolution Protocol
ARQ	Automatic Repeat reQuest
BPSK	Binary Phase Shift Keying
DC	Direct Current
DFS	Dynamic Frequency Selection
ETSI	European Telecommunications Standards Institute
FAQ	Frequently Asked Question
GPS	Global Positioning System
HP	Hypertext Transfer Protocol
ID	Identity
IEEE	Institute of Electrical and Electronic Engineers
IP	Internet Protocol
IQ	In phase / Quadrature
ISM	Industrial Scientific and Medical
ITU	International Telecommunications Union
LAN	Local Area Network
MAC	Medium Access Control Layer
MDI	Medium Dependent Interface
MDIX	Medium Dependent Interface Crossover
NLOS	non-Line-of-Sight
ODU	Outdoor Unit
OFDM	Orthogonal Frequency Division Multiplex
PC	IBM Compatible Personal Computer
PIDU Plus	Power Indoor Unit Plus
PING	Packet Internet Groper
POE	Power over Ethernet
PSU	Power Supply Unit
PTP	Point-to-Point
QAM	Quadrature Amplitude Modulation
RAM	Random Access Memory
STC	Space Time Coding
STP	Shielded Twisted Pair
TCP	Transmission Control Protocol
TPC	Transmit Power Control
URL	Universal Resource Location
USA	United States of America
UTP	Unshielded Twisted Pair
UV	Ultraviolet
VLAN	Virtual Local Area Network

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